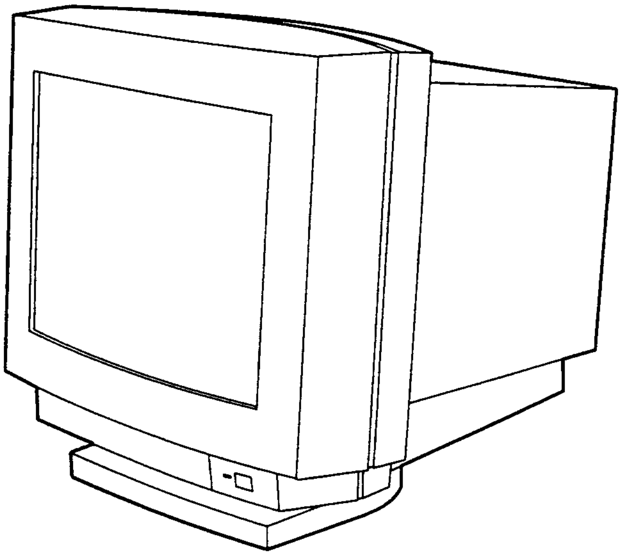
Service Manual

Nokia Display Products Oy
PB 14
FIN–24101 Salo, FINLAND

Chassis 447E

17” High Resolution Color Monitor



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PCB Documents

		058 1	058 2	058 3
Main Board	SMA	142G	142J	142M
Power Board	SMM	051GH	<	051J
RGB Board Assy	SMH	113EF	<	113F/G
Firmware		1.15	1.15	1.19

< no change, refer to the previous level

When re–ordering manuals, please quote the model name and part number.

ZB1551
05.96

Service

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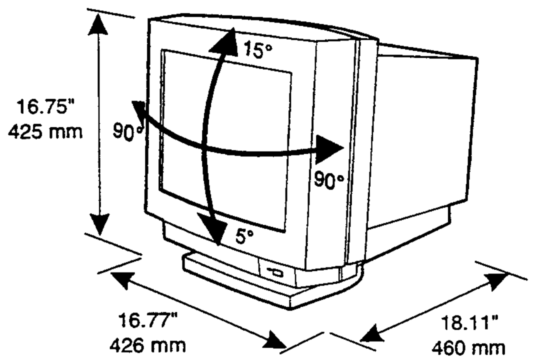
1. Product Overview

1.1. Technical Specifications

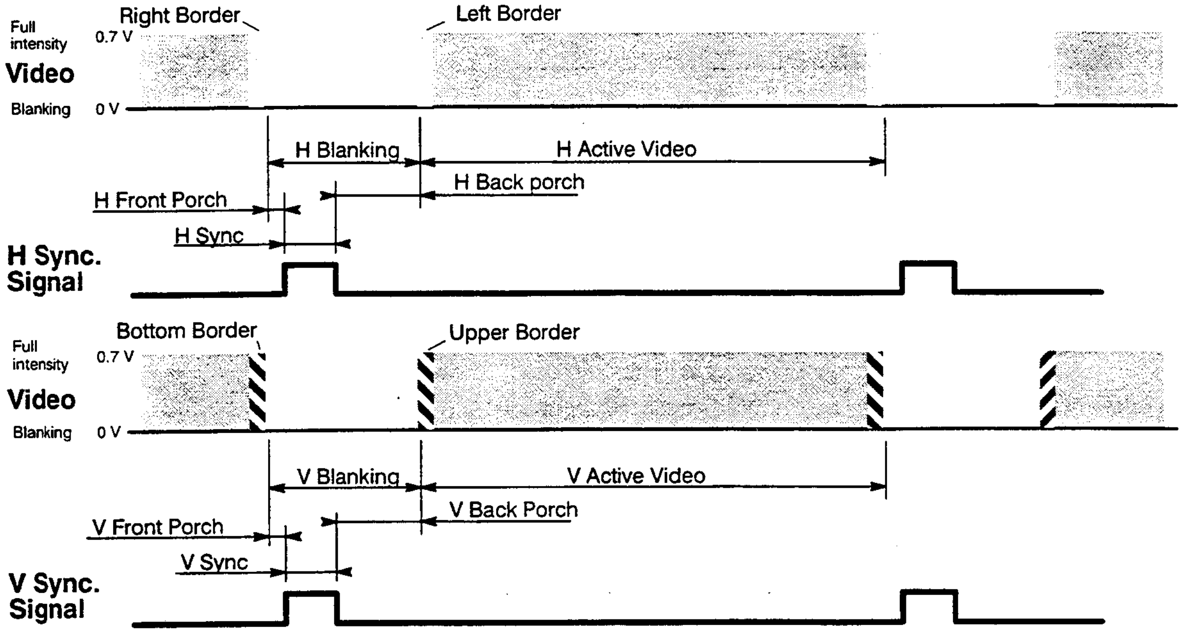
Cathode Ray Tube	17" in diagonal, 90° deflection angle Dark, antiglare, antistatic coating Short persistence (P22) Dot pitch 0.26 mm
Picture Size	300 mm x 225 mm with specified geometric distortion
Maximum Picture Size	313 mm x 235 mm
Power Input Requirements	Voltage 90–120/190–264 V, 60/50 Hz Autosense Current 2.0 A/110 V, 1.0 A/240 V Inrush current max. 30 A
Power Dissipation	< 180 W Normal Operation ~ 70 W Stand–by typical < 30 W Suspend < 8 W Auto power off
Geometric Distortion	Within 2 mm window in both vertical and horizontal dimensions
Luminance	Min. 95 cdm^{-2} at center, with full white field
Video Input	Input Signal: RGB, analog, positive, max 0.7 V/75 Ω Horizontal addressability: 1280 dots maximum Vertical addressability: 1024 dots maximum
Synchronization Range	Horizontal: 31 kHz to 82 kHz automatic Vertical: 50 Hz to 110 Hz automatic
Synchronization Signal	Separate TTL, positive/negative Composite TTL, positive/negative Composite, on green 0.3 V_{pp}, negative
Memory locations for user adjustments	18
Memory locations for factory adjustments	max. 14
Maximum Dot Frequency	Min. 140 MHz
Temperature	Operating: +10°C to +40°C Packed: –40°C to +60°C
Humidity	Operating: 15% to 85 % Packed: 5% to 95 %
Size, Weight, Tilt and Swivel	



Weight
22 kg net
25 kg gross

Specifications are subject to change without notice.

1.2. Preset Display Modes


Right Border
Left Border
Full intensity
0.7 V
Video
Blanking
0 V
H Blanking
H Active Video
H Back porch
H Front Porch
H Sync
H Sync. Signal
Bottom Border
Upper Border
Full intensity
0.7 V
Video
Blanking
0 V
V Blanking
V Active Video
V Back Porch
V Front Porch
V Sync
V Sync. Signal

Display Mode Name	NCE 100	NCE 200D	NCE 300	NCE 320	NCE 306	NCE 402	NCE 406	NCE 501	NCE 502	NCE 506	NCE 605	NCE 620
Controller Video Mode number	3	6	7	9		14		17	19	30	32	
H Frequency/kHz	31.472	31.467	31.472	37.855	37.500	48.077	46.875	48.363	56.491	60.023	79.979	64.252
H Period/µs	31.774	31.780	31.774	26.417	26.667	20.800	21.333	20.677	17.702	16.660	12.504	15.564
H Active Video/µs	25.420	25.423	25.420	20.320	20.317	16.000	16.162	15.754	13.650	13.003	9.481	11.636
H Resolution	640	720	640	640	640	800	800	1024	1024	1024	1286	1280
H Sync/µs	3.81	3.81	3.81	1.27	2.03	2.40	1.62	2.09	1.81	1.22	1.06	1.02
H Back Porch/µs	1.91	1.91	1.91	4.06	3.81	1.28	3.23	2.46	1.92	2.23	1.84	2.33
V Period/Lines	449	449	525	520	500	666	625	806	806	800	1066	1070
V Resolution	350	400	480	480	480	600	600	768	768	768	1024	1024
V Sync/Lines	2	2	2	3	3	6	3	6	6	3	3	6
V Back Porch/Lines	59	34	33	28	16	23	21	29	29	28	38	34
H Sync Polarity	+	–	–	–	–	+	+	–	–	+	+	–
V Sync Polarity	–	+	–	–	–	+	+	–	–	+	+	–
H Front Porch/µs	0.64	0.64	0.64	0.76	0.51	1.12	0.32	0.37	0.32	0.20	0.12	0.58
V Front Porch/Lines	38	13	10	9	1	37	1	3	3	1	1	6
Dot Frequency/MHz	25.177	28.320	25.177	31.495	31.500	50.000	49.500	65.000	75.020	78.750	135.64	110.00
Interlacing	no	no	no	no	no	no	no	no	no	no	no	no

Circuit Description

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1. Introduction

1.1. This Description

About the Content

This description handles one PCB at a time.
It starts with **SMM** board which contains following chapters:
Power Supply

The description proceeds with **SMA** board which contains following chapters:
Sync Processing
Phase Locked Loop PLL
Horizontal Deflection
Vertical Deflection Output Stage
High Voltage Generator
Convergence Corrections
Processor

The last chapter Video Amplifier handles **SMH** board.

Markings

In this description the component marking contains board identifier.

For example
R**M**15 is the resistor R15 on SM**M** board
R**A**15 is the resistor R15 on SM**A** board
R**H**15 is the resistor R15 on SM**H** board.

Note that the component markings in PCB layout documents and circuit diagrams at the end of the manual do not contain board identifier.

The component pin numbers are separated from the component marking with slant
e.g. ICA19/5 is pin number 5 of IC19 on SMA board.

Component markings:

R	Resistor
RT	Trimmer resistor
C	Capacitor
T	Transistor
L	Choke
M	Transformer
D	Diode
DZ	Zener diode
IC	Integrated Circuit
Q	Connector
X	Xtal

1.2. General

This microprocessor controlled 17 inch FS–multisync colour monitor has a maximum resolution of 1280 x 1024 dots. The frequency range for the horizontal sweep is 30 kHz to 82 kHz and 50 Hz to 110 Hz for the vertical sweep. Besides the separate horizontal (H-sync) and vertical (V-sync) synchronization signals, the monitor also functions with a composite synchronization signal (C-sync) and a synchronization signal connected to the green signal (G-sync). The monitor's power supply has an automatic mains voltage selection between the voltage ranges 110 VAC 60 Hz and 230 VAC 50 Hz.

1.3. Functional Blocks

The monitor contains following functional blocks:

Power Supply

- generates voltages for other blocks and demagnetization for the picture tube
- automatic mains voltage selector and power management switches

Sync. Processing

- buffers for incoming synchronizing signals
- polarity correction and pulse length normalization for the horizontal pulses
- signal source selector (separate, composite or G–sync)
- black level clamping pulse generator
- vertical sync separator and vertical sync enable for the automatic stand-by system

Phase Locked Loop

- delay circuit for phase adjustment and phase comparator and horizontal oscillator securing the correct phasing between horizontal sweep and video signal
- loop cancelling switches for C-sync/G-sync operation and lock-in detector

Vertical Deflection

- vertical oscillator and ramp generators for trapeze and orthogonality correction
- parabola wave generator for the E/W correction and E/W balance circuits
- vertical blanking pulse generator

Vertical Output

- matches impedance of the vertical deflection coil to the vertical oscillator
- takes care of vertical centring

High Voltage Generator

- Focus 1, Focus 2, G2 and regulated anode voltage for picture tube
- x-ray protection and beam current limiter circuits (BCL).

Horizontal Deflection

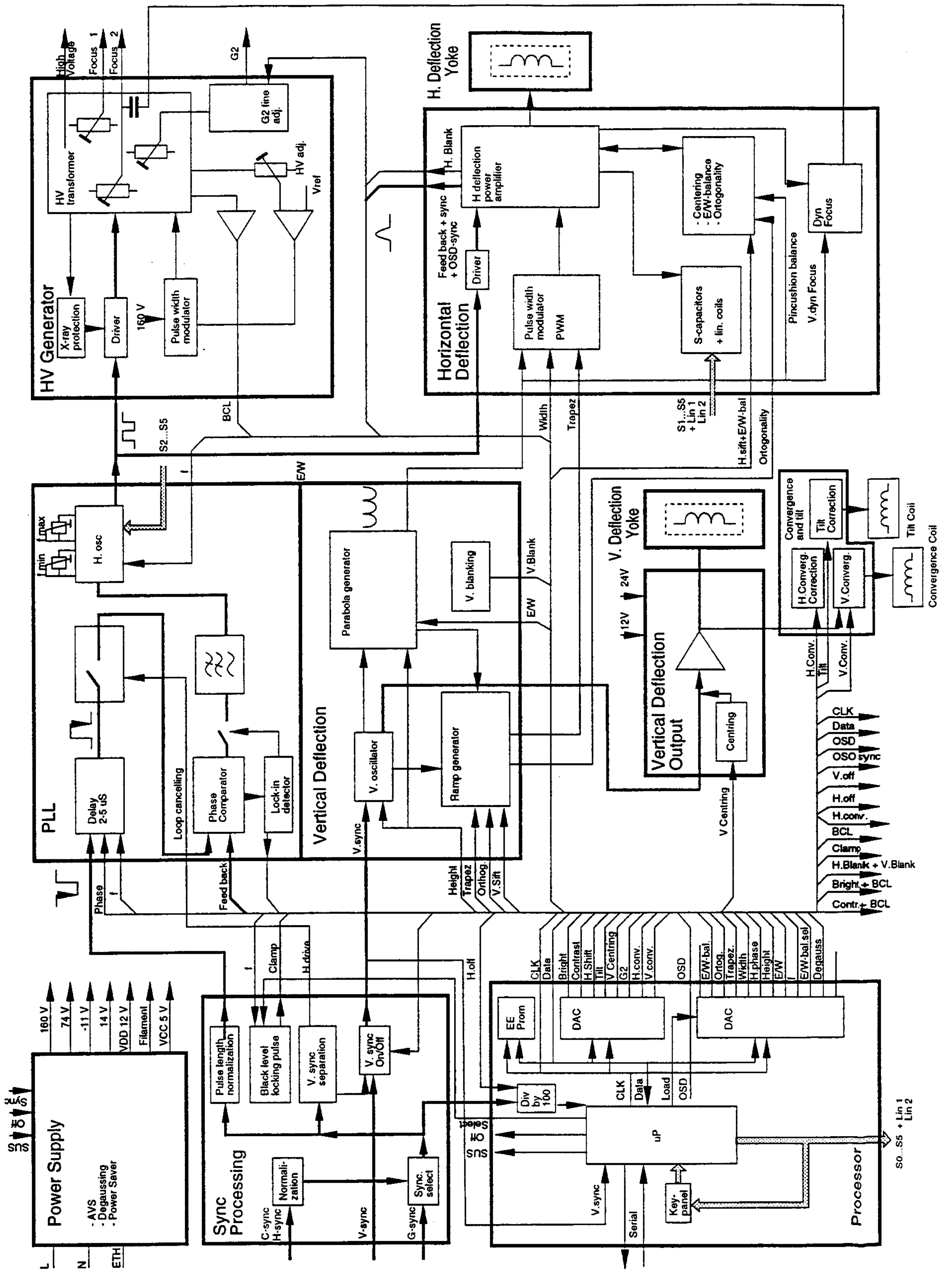
- driving circuit for horizontal deflection yoke
- current generator for horizontal raster centring
- orthogonality and E/W balance correction
- PWM for width and trapeze control
- dynamic focusing voltages

Convergence and Tilt Correction

- drive for vertical convergence and a tilt coils
- user adjustment for horizontal convergence.

Microprocessor

The processor unit's primary task is to identify the computer's display mode and select picture properties corresponding to the detected display mode. The processor controls user and service adjustments, power management as well as commands the horizontal oscillator and the selection of S-capacitors.


HV Generator
HV transformer
X-ray protection
Driver
160 V
Pulse width modulator
G2 line adj.
HV adj.
Vref
High Voltage
Focus 1
Focus 2
G2
BCL
S2...S5
H. Deflection Yoke
Horizontal Deflection
H deflection power amplifier
H. Blank
Feed back + sync + OSD-sync
Driver
Pulse width modulator PWM
Centering - E/W-balance - Ortogonality
S-capacitors + lin. coils
Dyn Focus
Pincushion balance
V.dyn Focus
Width
Trapez
S1...S5 + Lin 1 Lin 2
H.sift+E/W-bal
Ortogonality
E/W
PLL
H. osc
f max
f min
Delay 2-5 uS
Loop cancelling
Phase Comparator
Lock-in detector
Phase
Feed back
Vertical Deflection
Parabola generator
V. blanking
V.Blank
V. oscillator
Ramp generator
V.sync
Height
Trapez
Orthog.
V.Sift
V. Deflection Yoke
Vertical Deflection Output
12V
24V
Centring
V Centring
Convergence and tilt
Tilt Correction
H.Converg. Correction
V.Converg.
Tilt Coil
Convergence Coil
H.Conv.
Tilt
V.Conv.
CLK
Data
OSD
OSD sync
V.off
H.off
H.conv.
BCL
Clamp
H.Blank + V.Blank
Bright + BCL
Contr. + BCL
Power Supply
- AVS
- Degaussing
- Power Saver
160 V
74 V
-11 V
14 V
VDD 12 V
Filament
VCC 5 V
Sus
Off
Sync
L
N
ETH
Sync Processing
Pulse length normalization
Black level locking pulse
V. sync separation
V. sync On/Off
Normalization
Sync. select
C-sync H-sync
V-sync
G-sync
Clamp
H drive
H.off
Processor
EE Prom
DAC
DAC
Div by 100
uP
Key. panel
Serial
V.sync
Sus
Off
Select
CLK
Data
Load
OSD
CLK
Data
Bright
Contrast
H.Shift
Tilt
V Centring
G2
H.conv.
V.conv.
OSD
E/W-bal.
Ortog.
Trapez.
Width
H.phase
Height
E/W
E/W-bal.sel
Degauss
S0...S5 + Lin 1 Lin 2

Deflection/Power Supply/Synchronizing Block Diagram

Video Amplifier

The video amplifier is designed to drive a 17 inch picture tube with less than 150 MHz dot frequency. The video amplifier is formed by a three channel preamplifier, three output amplifiers, three black level adjustment and clamping circuits, a brightness adjustment circuit and a separator circuit for the G-sync signal. The video amplifier's properties are affected via I²C bus.

2. Power Supply

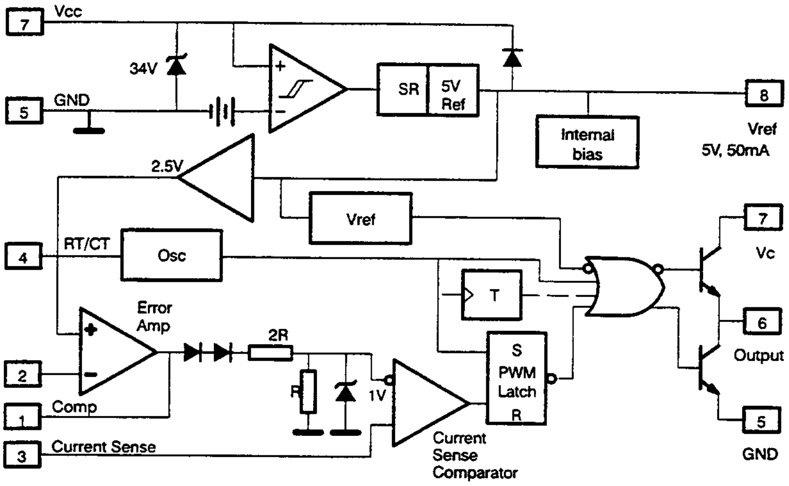
2.1. General

The power supply is secondary regulated, current mode controlled, fly–back switching type regulator. The mains voltage range is 110V ±15% or 230V ±15%. The power supply has automatic voltage range selector.

The switching frequency is synchronized to the horizontal deflection. The function is continuous but turns to discontinuous with small loads. The feedback information is transmitted from secondary to primary using an opto-isolator.

2.2. Regulator IC

The operation is controlled by a PWM regulator IC (UC3842).


7
Vcc
34V
5
GND
SR
5V
Ref
8
Internal
bias
Vref
5V, 50mA
2.5V
Vref
7
Vc
4
RT/CT
Osc
T
Error
Amp
2R
S
PWM
Latch
R
6
Output
2
R
1V
1
Comp
5
3
Current Sense
Current
Sense
Comparator
GND

UC3842 Block Diagram

The circuit contains error amplifier, RC oscillator, current sense comparator, 5V reference voltage, output drive circuit for switching transistor and under voltage lockout. The lockout circuit secures that the supply voltage is sufficiently high before the start-up of the circuit.

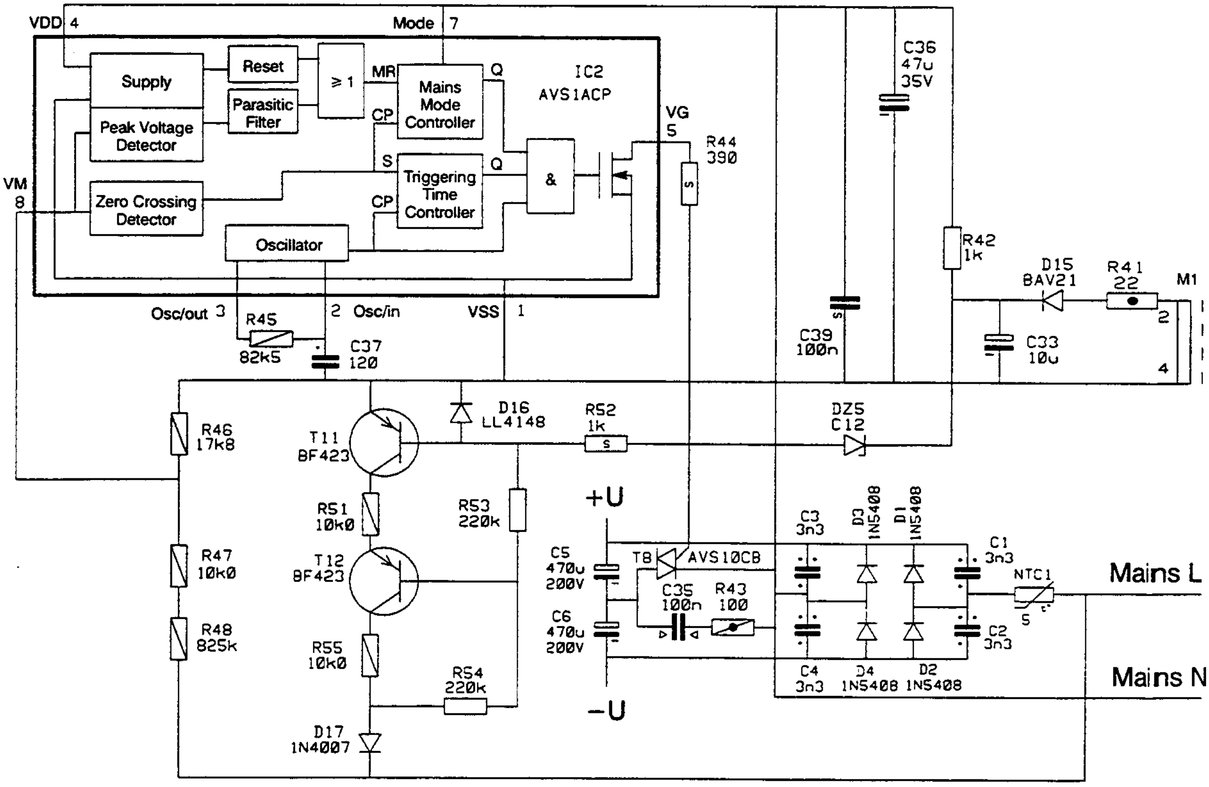
2.3. Automatic Mains Voltage Selector

The diodes DM1 – DM4 full wave rectifies the 150 – 264VAC mains voltage to the mains capacitors CM5 and CM6. If the mains voltage is less than 130V, the voltage range selector circuit ICM2 commands the triac TM8, which connects the centre point of CM5/CM6 to the connection point of the diodes DM3 and DM4. After this the diodes DM1 and DM2 together with the mains capacitors form a voltage doubling circuit which allows the power supply to function over the entire specified mains voltage range.

During start-up the supply voltage (9V) for ICM2 (pins 4/1) is fed through RM51, RM55 and TM11, TM12. When the secondary voltages have achieved a sufficient level, the supply voltage for ICM2 is taken from the transformer through the diode DM15. At the same time the zener DZM5 begins to conduct cutting off transistors TM11 and TM12.

Divider resistors RM46, RM47, RM48 form an AC voltage, proportional to the mains voltage, to the pin ICM2/8. Additionally the mains voltage zero crossing point is sensed from the voltage at pin ICM2/8. RM46, RM47 and RM48 have been selected to trigger TM8 on if the mains voltage is less than 130VAC during start-up.

TM8 is triggered on with negative pulse train at ICM2/5 after mains voltage zero crossing. The internal oscillator of ICM2 which generates the pulse train, has been set to 45kHz with R45/C37.


VDD 4
Mode 7
Supply
Reset
Parasitic Filter
≥ 1
MR
Mains Mode Controller
Q
IC2
AVS1ACP
Peak Voltage Detector
CP
VM 8
Zero Crossing Detector
S
Q
Triggering Time Controller
CP
&
Oscillator
VG 5
R44 390
C36 47u 35V
R42 1k
D15 BAV21
R41 22
M1
2
4
C39 100n
C33 10u
Osc/out 3
R45 82k5
2 Osc/in
C37 120
VSS 1
R46 17k8
T11 BF423
D16 LL4148
R52 1k
DZ5 C12
R51 10k0
R53 220k
+U
C3 3n3
D3 1N5408
D1 1N5408
C1 3n3
R47 10k0
T12 BF423
C5 470u 200V
T8 AVS10CB
C35 100n
R43 100
NTC1
Mains L
R48 825k
R55 10k0
C6 470u 200V
C2 3n3
R54 220k
C4 3n3
D4 1N5408
D2 1N5408
Mains N
−U
D17 1N4007

Mains Voltage Selector

2.4. Start-up

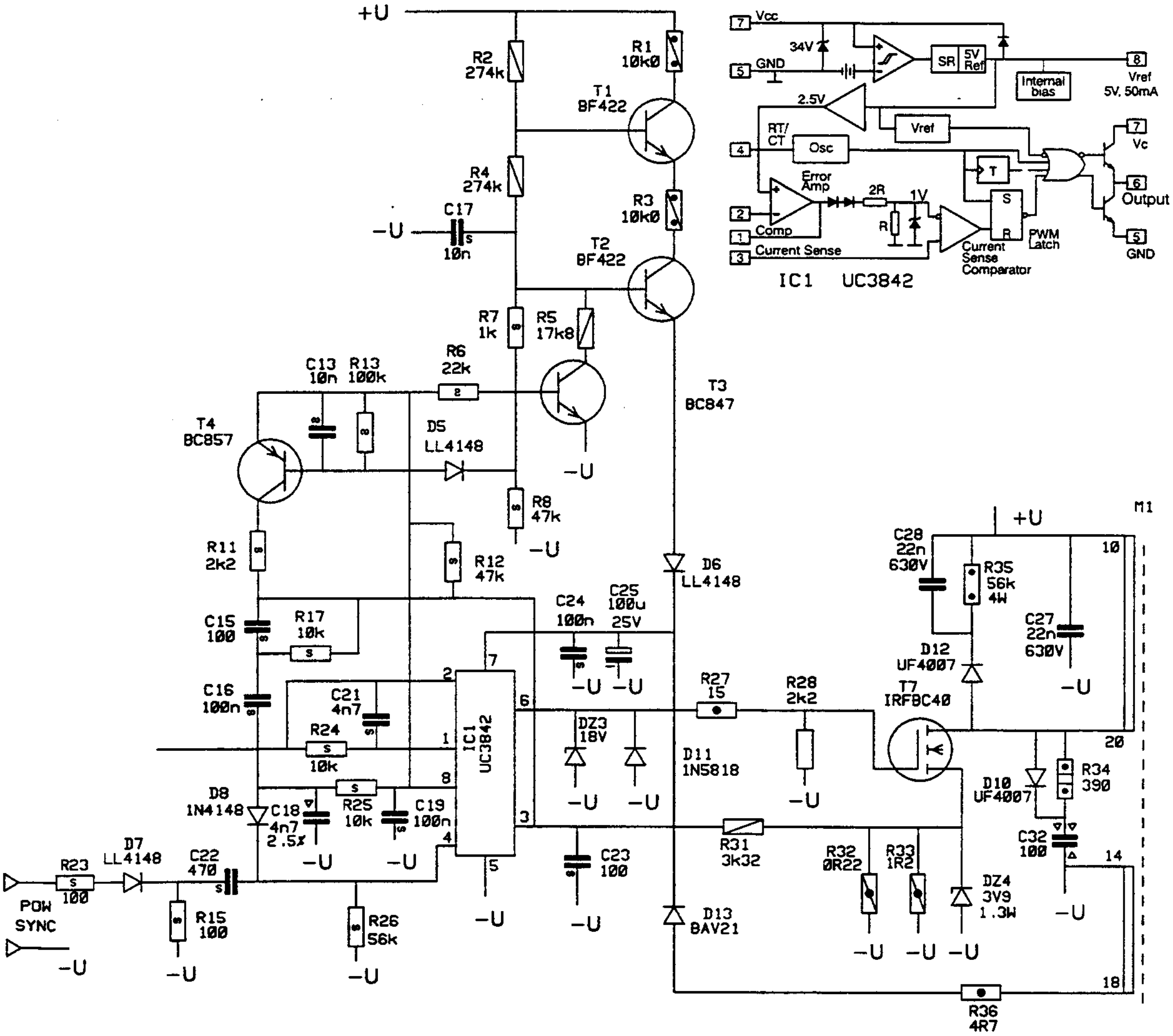
CM5, CM6 filter the rectified mains voltage. The ICM1 supply voltage capacitor CM25 starts to charge through RM1 and RM3. When the voltage in the capacitor achieves 16 volts, the under voltage lockout circuit enables the start-up of ICM1. Pin ICM1/8 rises to 5 volts which turns TM3 on and TM2 and TM1 off. At the same time the oscillator starts up and TM7 starts to conduct. The current through the primary of MM1 (pin 10 and 20) and TM7 starts to increase until the voltage drop over the current sense resistors RM6 and RM7 is equal to the internal 1 volt reference of the current sense comparator. At the moment the current sense comparator switches TM7 off, the energy stored in the transformer, discharges to the capacitors in the secondary circuits. After several cycles the secondary capacitors are charged to adequate voltages and the secondary regulator turns on to regulate the current sense comparator's reference voltage and thus the current in the primary coil.

During normal operation, TM1 and TM2 are switched off and the IC gets its supply voltage through the winding MM1/18 and DM13. If the IC's supply voltage goes under 10 volts during the start-up, the under voltage lockout circuit disables the IC and the start-up procedure starts again.

2.5. Synchronization of the Power Supply

The power supply is synchronized to the horizontal deflection. The fly-back pulses from the horizontal deflection (M5) are fed through RM23, DM7 and CM22 to the oscillator input pin ICM1/4. These positive pulses trigger ICM1 and this switches TM1 on.

The power supply's free running frequency is 25 kHz and it must be lower than that of the horizontal oscillator (27 kHz). The frequency is determined by the values of CM18 and RM25.


+U
R2 274k
R1 10k0
T1 BF422
R4 274k
C17 10n
-U
R3 10k0
T2 BF422
R7 1k
R5 17k8
R6 22k
C13 10n
R13 100k
T3 BC847
T4 BC857
D5 LL4148
R8 47k
R11 2k2
R12 47k
D6 LL4148
C15 100
R17 10k
C24 100n
C25 100u 25V
C16 100n
C21 4n7
R24 10k
IC1 UC3842
DZ3 18V
R27 15
R28 2k2
D11 1N5818
D8 1N4148
C18 4n7 2.5%
R25 10k
C19 100n
D7 LL4148
R23 100
C22 470
POW SYNC
R15 100
R26 56k
C23 100
R31 3k32
D13 BAV21
R32 0R22
R33 1R2
DZ4 3V9 1.3W
R36 4R7
C28 22n 630V
R35 56k 4W
C27 22n 630V
D12 UF4007
T7 IRFBC40
D10 UF4007
R34 390
C32 100
M1
10
20
14
18
Vcc
34V
SR
5V Ref
GND
Internal bias
Vref 5V, 50mA
2.5V
RT/CT
Osc
Vref
Vc
Error Amp
2R
1V
R
S
Output
Comp
Current Sense
Current Sense Comparator
PWM Latch
IC1 UC3842

Start-up, Synchronization, Under Voltage Control and Slope Compensation of the Power Supply

2.6. Under Voltage Control

If the mains voltage goes under about 150V (230V) or under about 80V (115V), the base voltage of TM4 goes under the emitter base threshold voltage, the transistor gets base current and starts to supply more current through RM11 to pin ICM1/3. Then the control circuit stops to drive the TM7 and the power supply shut down.

2.7. Slope Compensation

Because the primary current's pulse ratio may exceed 50 %, the circuit has been provided with a slope compensation in order to secure a stable operation in every situation. The oscillator's sawtooth wave is added as a compensation to the voltage on the current sense pin ICM1/3 by CM16 and RM17.

2.8. Voltage Regulation

The feedback information is taken from the 160V line. The voltage is reduced with RM68, RM83, RM82, RTM1 and RM89 to 2.5V for the regulator TM18. The regulator TM18 can be considered as an inverting amplifier with an internal reference voltage of 2.5V.

If the 160V voltage level tends to rise, the TM18 grid voltage increases, which increases the current through TM18. The voltage drop over RM86 increases, which decreases the current through the opto isolator diode (ICM3/1&2). As the opto isolator's transistor current is related to the diode current, the transistor current also decreases. The voltage on the pin ICM3/5 (and ICM1/2) increases, which makes the pin ICM1/1 (output of the inverting error amplifier) to decrease. Simultaneously, the current sense comparator's reference voltage (inside the ICM1) decreases and the maximum current through the current measuring resistors and through MM1 primary winding decreases. The energy stored in the transformer per cycle decreases, which also decreases the voltage level of the 160V line.

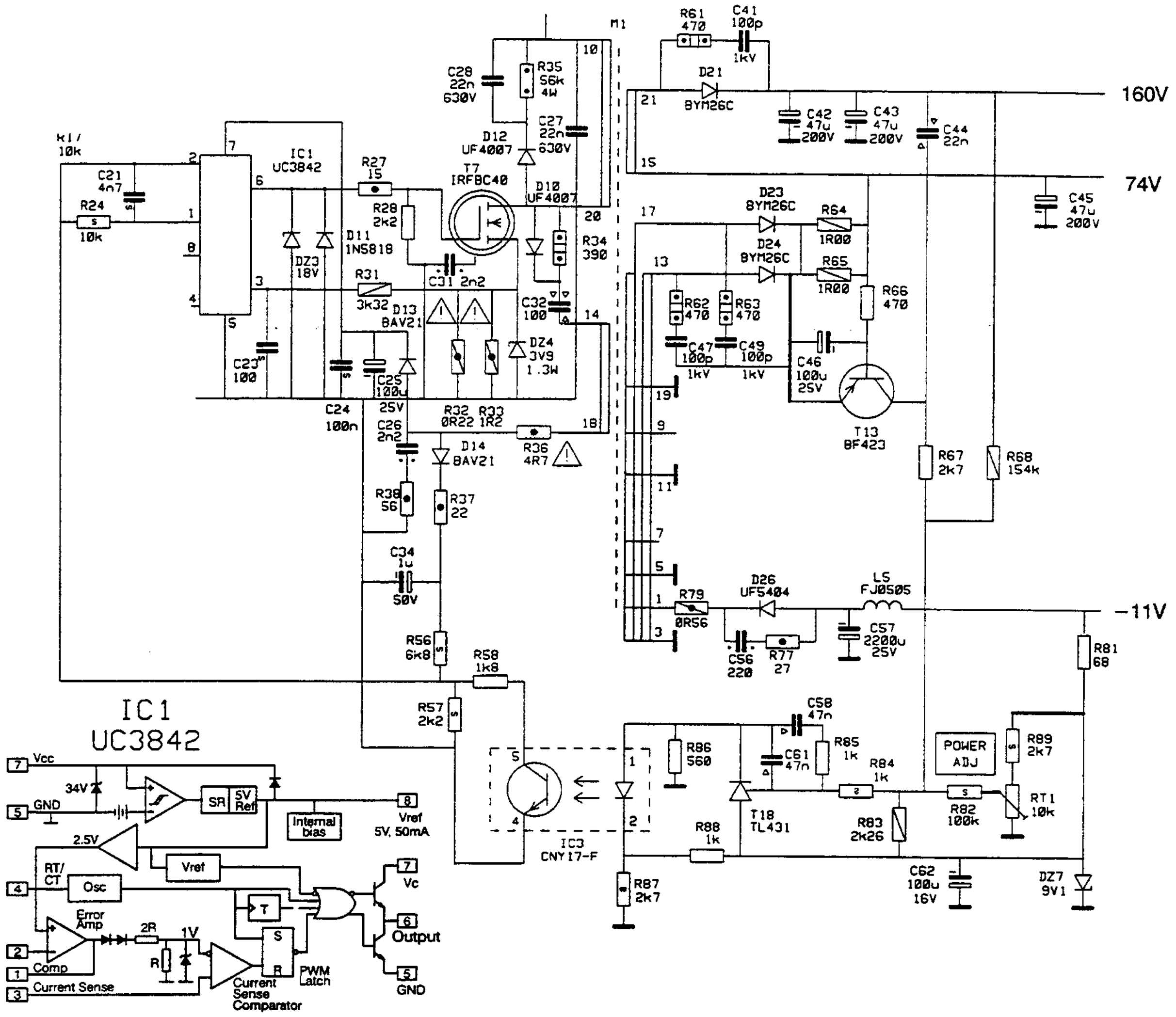
2.9. Secondary Current Limiter

The current in 160V and 70V windings flows trough RM64/RM65. If an overload causes a DC voltage drop over the resistors which is higher than the threshold voltage of the base emitter junction, TM13 starts to conduct and gives additional current to the 160V sensing line (RM67). TM18 interprets this as a rising voltage at 160V line and starts to decrease it. At the same time the voltage at pin MM1/18 decreases. When this voltage goes below 10V level, the under voltage lockout circuit inside ICM1 disables the operation. The power supply tries to start again after approximately 50 ms. If the overload has not disappeared, the over current limiter function is repeated.

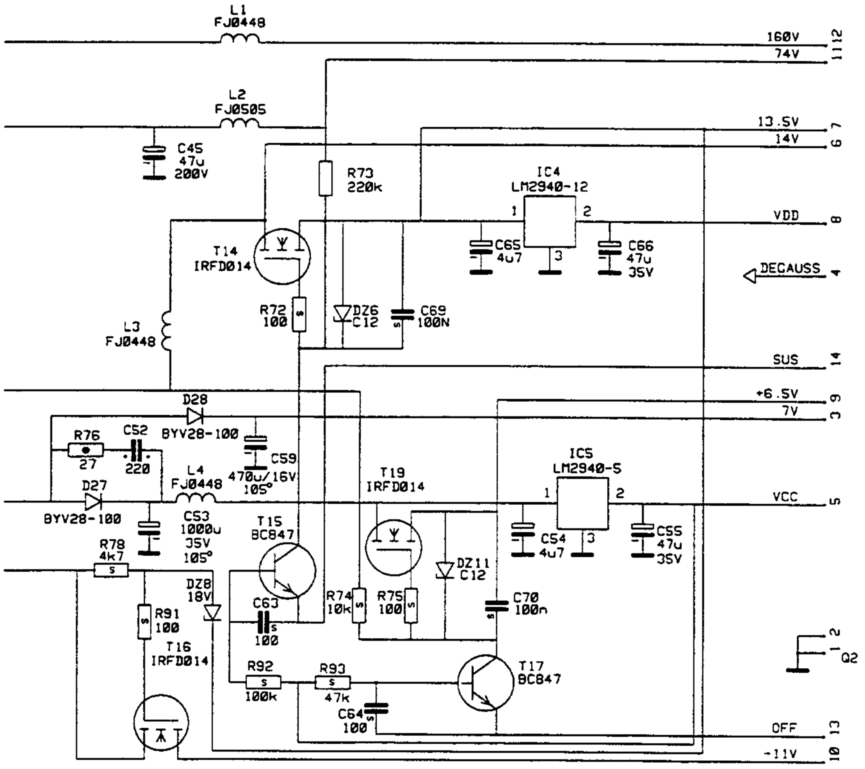
2.10. Power Management Switches

In the suspend state the sus–line is pulled down. TM15 starts to conduct and switches TM14 off. As a result +13,5 and V_{DD} voltage lines are cut off. At the same time TM16 is switched off via DZM8 and also −11V line is cut off. Consequently, horizontal oscillator, horizontal deflection, high voltage generator and vertical deflection stop working and the power consumption falls to near 10W.

In the off state also the off–line is pulled down. TM17 starts to conduct and switches TM19 off. This cuts off filament and the power consumption drops to 5 W.


160V
74V
-11V
M1
IC1
UC3842
T7
IRFBC40
R61 470
C41 100p 1kV
D21 BYM26C
C42 47u 200V
C43 47u 200V
C44 22n
C45 47u 200V
R35 56k 4W
C28 22n 630V
C27 22n 630V
D12 UF4007
D10 UF4007
R34 390
R17 10k
C21 4n7
R24 10k
R27 15
R28 2k2
D11 1N5818
DZ3 18V
R31 3k32
D13 BAV21
C31 2n2
C32 100
DZ4 3V9 1.3W
C23 100
C24 100n
C25 100u 25V
C26 2n2
R32 0R22
R33 1R2
R36 4R7
D14 BAV21
R38 56
R37 22
C34 1u 50V
R56 6k8
R58 1k8
R57 2k2
D23 BYM26C
D24 BYM26C
R64 1R00
R65 1R00
R66 470
R62 470
R63 470
C47 100p 1kV
C49 100p 1kV
C46 100u 25V
T13 BF423
R67 2k7
R68 154k
D26 UF5404
L5 FJ0505
R79 0R56
C56 220
R77 27
C57 2200u 25V
R81 68
C58 47n
R86 560
C61 47n
R85 1k
R84 1k
T18 TL431
R83 2k26
R82 100k
POWER ADJ
R89 2k7
RT1 10k
IC3 CNY17-F
R88 1k
R87 2k7
C62 100u 16V
DZ7 9V1
IC1
UC3842
Vcc
34V
GND
SR
5V Ref
Internal bias
Vref 5V, 50mA
2.5V
Vref
RT/CT
Osc
T
Error Amp
2R
R
1V
Comp
Current Sense
S
R
Current Sense Comparator
PWM Latch
Vc
Output
GND

Voltage Regulation and Secondary Current Limiter


L1 FJ0448
160V
74V
L2 FJ0505
13.5V
14V
C45 47u 200V
R73 220k
IC4 LM2940-12
VDD
T14 IRFD014
C65 4u7
C66 47u 35V
DECAUSS
R72 100
DZ6 C12
C69 100N
L3 FJ0448
SUS
D28
+6.5V
7V
R76 27
C52 220
BYV28-100
C59 470u/16V 105°
IC5 LM2940-5
D27 BYV28-100
L4 FJ0448
T19 IRFD014
VCC
C53 1000u 35V 105°
T15 BC847
C54 4u7
C55 47u 35V
R78 4k7
DZ8 18V
DZ11 C12
C63 100
R74 10k
R75 100
C70 100n
R91 100
T16 IRFD014
R92 100k
R93 47k
T17 BC847
C64 100
Q2
OFF
-11V

Power Management Switches

3. Sync Processing

3.1. Normalization of the Synchronization Signal

The separate horizontal synchronizing pulses are coupled via inverter ICA1A to the EX–OR circuits ICA2B which inverts the negative pulses while positive pulses go through without inversion. The circuit generates always positive sync pulses on its output whether the incoming pulse polarity is positive or negative. The horizontal sync pulse are made equal in width with CA22/RA11 before sending to the delay circuit ICA28.

After normalization the horizontal pulses are sent to the black level clamping pulse generator and to the microprocessor.

The vertical sync pulses have no polarity correction but they are sent directly to the vertical oscillator and to the microprocessor through vertical sync enable gate ICA1D

3.2. Sync Priority

This monitor does not contain a separate line for the composite horizontal/vertical synchronizing signal (C–sync), but this line is the same as the horizontal sync line (H sync connector pin QA1/5). Also the sync signal combined in the video signal (G–sync) is added to this same point after a priority selection.

The use of a separate sync signal or a composite horizontal/vertical synchronization signal disables the use of a sync signal combined with the video signal. The horizontal pulses are rectified to the pin ICA1/9. If a separate horizontal signal or composite sync signal is used, pin ICA1/9 goes high and disables the G–sync signal on the pin ICA1/8 to go forward.

3.3. Separation of Vertical Pulse

The integrator time constant RA15/CA4 separates vertical pulses from the composite sync signal or G–sync signal. The gate ICA2A functions as a comparator while the positive feedback chain RA13, RA14 forms the necessary hysteresis. The separated synchronization pulses are sent further through the gates ICA2A and ICA1D to the vertical oscillator, to the microprocessor and through gate ICA3D to the loop cancelling gate ICA3C.

3.4. Black Level Clamp Pulse

The timing of the blacklevel clamping pulse can be selected
- clamping during the synchronization pulse (sync tip clamping)
- clamping during the back porch of the signal (back porch clamping)

When sync tip clamping is used, the clamping pulse starts with the leading edge of the horizontal sync pulse. This clamping can be used if the video signal does not contain synchronization pulses. When back porch clamping is used the clamping pulse starts after the sync pulse. This method must be used when the video signal contains synchronization pulses.

Horizontal sync pulses trigger the monostable ICA4B. The pulse width of the monostable is about 600 ns at 82 kHz line frequency and about 1000 ns at 30 kHz line frequency. The pulse width is determined by CA12 and TA18 current which charges CA12. TA18 is controlled with a voltage (ICA11/18) proportional to the line frequency. At low frequencies the current is low causing longer clamp pulse than at higher frequencies.

The clamp pulse timing is controlled by the processor through the pin ICA25/15. If the line is high, the gate ICA2C inverts the coming sync pulses and thus the monostable IC4B/9 is triggered with rising edge of the sync pulse (sync tip clamping). If the line is low the monostable is triggered with falling edge of the sync pulses (back porch clamping). The clamp pulses are brought from the monostaple's output ICA4B/12 to the black level clamp circuit on the video amplifier board.

If the monitor gets no sync pulses the monostable is triggered with pulses taken from horizontal oscillator output. This pulses are brought to ICA4/10. Because the horizontal lock detector ICA14D forces pin ICA4/9 low, the monostable is triggered with horizontal drive pulses on ICA4B/10. This ensures the pulse availability in every situation.

4. Phase Locked Loop PLL

4.1. Horizontal Oscillator

ICA8 (TDA4852) contains horizontal oscillator. Only horizontal oscillator and horizontal output driver (pin 3) of the IC are used and pins ICA8/9 & 2 have been grounded.

The oscillator is a relaxation type and requires a fixed capacitor of 10 nF at pin ICA8/19. By changing the current into pin ICA8/18 the whole frequency range from 13kHz to 100kHz can be covered. The higher the current taken from pin ICA8/18 the higher the frequency. A microprocessor controlled frequency to voltage converter ICA11/19 drives through ICA9B the oscillator approximately to the correct frequency according to the actual signal frequency. A fine adjustment is done by TA61. This transistor loads the pin ICA8/18 according to the voltage level coming from the phase detector ICA29 so that both the frequency and phase are regulated exactly.

The limits for the frequency range (30kHz to 82kHz) are adjusted with trimmers RTA1 and RTA2. First the connector QA16 is short circuited and the monitor is driven with 82 kHz input signal. The processor measures the signal frequency and sets pin ICA11/19 to 0V. Then also pin ICA9/7 remains low. The frequency of the horizontal oscillator is adjusted now to 77 kHz by using the trimmer RTA2. Next the monitor is driven with 31.5 kHz input signal and the processor sets the pin ICA11/19 to 5V and then pin ICA9/7 is near 8 volts. The frequency of the horizontal oscillator is adjusted now to 27 kHz with the trimmer RTA1. Note that frequencies must be set about 5 kHz below the drive frequency because the fine adjustment with TA61 can only rise the frequency by sinking more current from pin ICA8/18.

ICA9A&B is a protection circuit for the line output stage. Low line frequency with too small S–capacitor value may cause damages in the line output stage. The voltages on the S–capacitor selection lines are weighed in resistor chain RA69, RA72, RA79, RA72, RA74 and summed to input ICA9B/5. Note that the voltage in the output ICA9B/7 is equal to input ICA9B/5. If the voltage at IC9A/3 tries to rise higher than deduced from the S–line selection, DA7 starts to conduct preventing ICA9A/3 to rise. This prevents the line frequency to fall too low.

The horizontal output signal is taken from pin ICA8/3. This signal provides drive voltage for high voltage generator's switching transistor TA9 and for line deflection switching transistor TA32. Furthermore this signal provides triggering for the pulse width modulators ICA18 and ICA30 and for clamp pulse generator ICA4.

4.2. Phase Comparison

ICA29 is an edge-sensitive phase comparator. The delayed sync pulses are brought from the pin ICA3/10 to the pin ICA29/3 and the inverted feedback from horizontal deflection stage is linked to pin ICA29/14 through CA212 and RA229. The phase comparator tends to match the timing of the leading edge of the delayed sync pulse and the trailing edge of the feedback pulse. In practice the output of the phase comparator is loaded by a line frequent pulses through RA291 in order to keep the output pulses always positive in normal operation. This means that the trailing edge of the feedback pulse appears 400 ns before the sync pulse's leading edge.

If the deflection frequency tends to slow down compared to the sync pulse frequency, the phase comparator generates shorter positive pulses on pin ICA29/13. After low–pass filtering with RA352 and CA26 the control voltage of TA61 base decreases, the transistor sinks more current from pin ICA8/18 and the frequency is adjusted upwards corresponding to the sync pulses. If the frequency increases, the phase comparator generates longer positive pulses, which drives the control voltage up and the oscillator frequency captures the sync signal frequency.

4.3. Sync Signal Delay and Phase Control

The delaying of the sync pulses moves the video information compared to the feedback pulses. This means that the position of the picture moves compared to the frame. The phase control range is about 1 to 4µs at 82kHz and about 1.5 to 6µs at 30kHz compared to the feedback pulse's trailing edge.

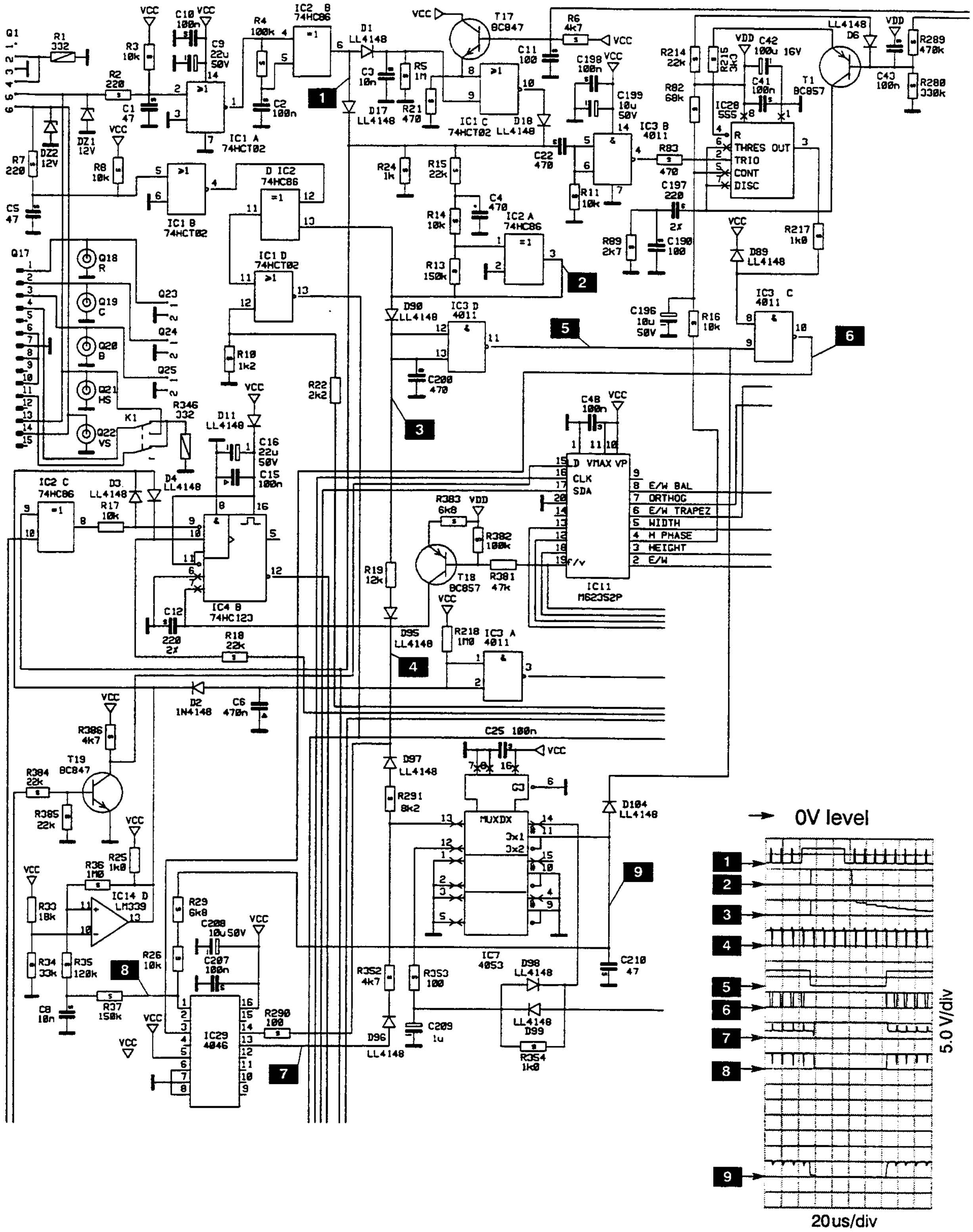
ICA28 (timing circuit 555) functioning as a monostable multivibator is used to delay the sync pulses. When triggered by the trailing edge of the sync pulse applied to the pin ICA28/2, the monostable generates a positive pulse with width equal to the delay. The delay is determined by CA197, CA190 and current generator TA1 and the threshold voltage of the pin ICA28/5. The length of the delay can be adjusted by changing the voltage at pin ICA28/5 with DA–converter ICA11/4. The current generator TA1 is used to decrease the phase adjustment range at high frequencies. At high frequencies the base of TA1 is low, the current through the transistor is high and CA197 charges faster causing shorter delay.

Delayed positive pulses are coupled through the inverter ICA3C to the phase comparator.

4.4. Loop Cancelling

In case of C-sync or G-sync, it is possible that the horizontal phase is lost during vertical sync pulse. The horizontal pulses may be missing, there are extra pulses or the phase of the pulses is changed. Therefore it is necessary to prevent the phase comparison during the vertical sync pulse.

Gate ICA3C and switch ICA7 are used to open the phase locked loop during vertical sync pulse. When the sync separator ICA2A detects a vertical sync pulse, it drives pins ICA3D/12 & 13 high and pin 11 goes low. This prevents the sync pulses at ICA3C/8 from going to the phase comparator ICA29/3. At the same time the pin ICA7/10 is driven low and a connection between ICA7/1 & 15 is opened. The phase locked loop is now open and the control voltage of the horizontal oscillator remains at the level it was before the vertical sync pulse. When the vertical sync pulse ends, ICA3C and ICA7 are not switched on immediately but after a delay of three horizontal lines. The delay is arranged with CA200 which is needs three horizontal sync pulses to discharge through RA19. This ensures that the loop is not closed before the sync pulses are correct again.


Q1
R1 332
R2 220
R3 10k
C1 47
C10 100n
C9 22u 50V
R4 100k
IC2 B 74HC86
IC1 A 74HCT02
C2 100n
D1 LL4148
VCC
T17 BC847
R6 4k7
C3 10n
R5 1M
D17 LL4148
R21 470
C11 100
IC1 C 74HCT02
D18 LL4148
C198 100n
C199 10u 50V
IC3 B 4011
R214 22k
R215 3k3
C42 100u 16V
C41 100n
T1 BC857
D6 LL4148
VDD
R289 470k
R288 330k
C43 100n
R82 68k
IC28 555
R
THRES OUT
TRIG
CONT
DISC
R83 470
C197 220 2%
C22 470
R11 10k
R24 1k
R15 22k
C4 470
R14 10k
IC2 A 74HC86
R13 150k
R89 2k7
C190 100
R217 1k0
D89 LL4148
DZ2 12V
DZ1 12V
R7 220
R8 10k
C5 47
IC1 B 74HCT02
D IC2 74HC86
IC1 D 74HCT02
Q17
Q18 R
Q19 C
Q20 B
Q21 HS
Q22 VS
Q23
Q24
Q25
K1
R346 332
R10 1k2
D90 LL4148
IC3 D 4011
C200 470
R22 2k2
C196 10u 50V
R16 10k
IC3 C 4011
D11 LL4148
C16 22u 50V
C15 100n
IC2 C 74HC86
D3 LL4148
D4 LL4148
R17 10k
IC4 B 74HC123
C12 220 2%
R18 22k
C48 100n
VMAX VP
LD
CLK
SDA
E/W BAL
ORTHOG
E/W TRAPEZ
WIDTH
H PHASE
HEIGHT
E/W
IC11 M62352P
R383 6k8
R382 100k
R381 47k
T18 BC857
R19 12k
D95 LL4148
R218 1M0
IC3 A 4011
D2 1N4148
C6 470n
R386 4k7
T19 BC847
R384 22k
R385 22k
C25 100n
D97 LL4148
R291 8k2
MUXDX
IC7 4053
D104 LL4148
C210 47
R25 1k0
R36 1M0
IC14 D LM339
R33 18k
R34 33k
R35 120k
C8 10n
R37 150k
R26 10k
R29 6k8
C208 10u 50V
C207 100n
IC29 4046
R290 100
R352 4k7
R353 100
C209 1u
D96 LL4148
D98 LL4148
D99 LL4148
R354 1k0
1
2
3
4
5
6
7
8
9
0V level
5.0 V/div
20us/div

4.5. Lock-in Detector

The information that the phase locked loop is not locked to the sync pulses, other words a monitor is not running synchronous with the sync signal, is available at pin ICA4D/13. This signal is used to select the correct triggering signal to the black level clamping pulse generator. Furthermore this signal is used to blank the picture and to narrow the picture during a mode change. These functions are made by pulling the contrast line and the width adjustment line down with TA3

5. Horizontal Deflection

5.1. Pulse Width Modulator and Picture Width Adjustment

The monostable multivibrator ICA18 is triggered by the trailing edge of the horizontal oscillator pulse and generates one constant width pulse for each trigger pulse. The pulse from ICA18/11 controls TA27 which transfers the pulse to 160V level. These pulses are filtered in the choke coil MA4 to produce the supply voltage to the line output stage ICA19. Because the output pulse width of the monostable is independent from frequency, the pulse ratio varies with frequency. The ratio is higher for a higher frequency than for a lower frequency. After rectifying (DA33–DA36) the voltage provided for the line output stage is higher for higher frequency, which means that the supply voltage is adjusted automatically according to the line frequency.

The picture width adjustment affects to the pulse width of the monostable. The picture width adjustment voltage is available in D/A converter pin ICA11/5. It is coupled to the emitter of TA50 and controls the current in constant current generator TA50. When the adjustment voltage decreases, the current through TA50 increases and the voltage level at TA60 base decreases. The current through TA60 increases and CA115 charges more rapidly and the output pulse from the monostable is shorter, which makes the picture narrower.

The East/West correction parabola wave is added to the TA50 emitter by TA10 and the trapezoidal correction ramp is added to the same point through RA112.

TA29 limits the current through the switching transistor TA27. It normally conducts but if the voltage drop over RA224 reaches the TA29 base emitter threshold voltage, the transistor is closed. As a result the reset pin ICA18/13 goes low. The pulse width modulator's time constant capacitor CA115 is charged very rapidly through a ICA18 internal transistor and the driving to the switching transistor is cut off immediately.

5.2. Horizontal Centring

The tasks of ICA19 (TDA2040) are horizontal centring, orthogonal correction and E/W balance correction. Operational amplifier coupled IC19 works as a current generator. Its current can be controlled with TA24. The current flows through the hor yoke causing required displacement of the frame.

The centre (pin 5) point of MA4 is connected via RA209 to the S–correction capacitors. This means that the supply voltage (ca. ±5V) for ICA19 is floating over the voltage stored in the S–correction capacitors.

TA24 is off if the base voltage of TA24 has been adjusted below 0.6V. In this case there is no current through RA207 and no voltage drop exists over it. In operational amplifier due to large amplification factor, the inputs have practically same voltage. In other words the voltage at the pin ICA19/1 is equal to that of ICA19/2. This means that the voltage drop over RA209 is equal to the voltage over diodes DA32 and DA39 and there must be current flowing through RA209. This current is coming from pin ICA19/4 flowing through LA3 and MA3/3 & 5 to the pin 1 of hor yoke and further through the deflection yoke to the S–correction capacitors. From the S–correction capacitors the current flows through MA7/9&10 and RA209 back to the transformer MA4/5.
When passing through the deflection yoke, the current invokes a frame displacement.

If the base of the TA24 has been adjusted so that current also starts to flow through the transistor, there will be a voltage drop over RA207 causing the voltage drop over RA209 to decrease.

When the voltage drop over RA207 is equal to that in diodes DA32 and DA39, the voltage drop over RA209 is zero and there is no centring current. If the TA24 control current is increased further, the voltage drop over RA207 is greater than that of the diodes and correspondingly the voltage drop over RA209 turns negative. When the voltage drop over RA207 is twice the diodes threshold voltage, the centring current is equal in magnitude but opposite as in the case where TA24 was off.

5.3. S-capacitors and Linearity

To obtain a linear horizontal sweep, the monitor is provided with S–correction capacitors. One of these is permanently connected and others are selectable. The processor measures the frequency of the sync pulses and controls the switching transistors on the lines S0 ... S5 according to the required line frequency.

Besides the selection of the S–correction capacitors, the inductance of the linearity coil L8 is also decreased using the parallel coils LA4 and LA5.

The S–capacitors are selected according to the following table

Frequency range/Hz	Fixed 330 nF	S5 2.2 µF	S4 1 µF	S3 470 nF	S2 220 nF	S1 100 nF	S0 51 nF	Total nF	Lin 1	Lin 2
<30499	x	x	x	x	x	x	x	4371		
30499–30668	x	x	x	x	x	x		4320		
30669–30835	x	x	x	x	x		x	4271		
30836–31011	x	x	x	x	x			4220		
31012–31254	x	x	x	x		x	x	4151		
31255–31437	x	x	x	x		x		4100		
31438–31617	x	x	x	x			x	4051		
31618–31806	x	x	x	x				4000		
31806–32185	x	x	x		x	x	x	3901		
32186–32385	x	x	x		x	x		3850		
32386–32581	x	x	x		x		x	3801		
32582–32789	x	x	x		x			3750		
32790–33077	x	x	x			x	x	3681		
33078–33295	x	x	x			x		3630		
33296–33508	x	x	x				x	3581		
33509–33734	x	x	x					3530		
33735–34470	x	x		x	x	x	x	3371		
34471–34716	x	x		x	x	x		3320		
34717–34958	x	x		x	x		x	3271		
34959–35216	x	x		x	x			3220		
35217–35573	x	x		x		x	x	3151		
35574–35844	x	x		x		x		3100		
35845–36110	x	x		x			x	3051		
36111–36394	x	x		x				3000		
36395–38333	x	x						2530		
38334–38673	x	x				x		2630		
38674–39008	x	x					x	2581		
39008–39367	x	x						2530		
39368–42203	x		x	x	x	x	x	2171	x	
42204–42659	x		x	x	x	x		2120	x	
42660–43109	x		x	x	x		x	2071	x	
43110–43594	x		x	x	x			2020	x	
43595–44277	x		x	x		x	x	1951	x	
44278–44803	x		x	x		x		1900	x	
44804–45327	x		x	x			x	1851	x	
45328–45891	x		x	x				1800	x	
45892–49002	x		x					1330	x	
49003–49978	x		x			x	x	1481	x	
49979–50738	x		x			x		1430	x	
50739–51502	x		x				x	1381	x	
51503–52336	x		x					1330	x	
52337–55218	x			x	x	x	x	1171	x	
55219–56249	x			x	x	x		1120	x	
56250–57295	x			x		x		900	x	
57296–58449	x			x				1020	x	
58450–60127	x			x		x	x	951	x	
60128–61464	x			x		x		900	x	
61465–62837	x			x			x	851	x	
62838–64368	x			x				800	x	
64369–67691	x				x	x	x	701	x	
67692–69617	x				x	x		650	x	
69618–71631	x				x		x	601	x	x
71632–73925	x				x			550	x	x
73926–77411	x					x	x	481	x	x
77412–80330	x					x		430	x	x
80331–83470	x						x	381	x	x
>83470	x							330	x	x

For following horizontal frequencies the S–capacitor selection is exeptional:

Frequency/Hz	Fixed 330 nF	S5 2.2 µF	S4 1 µF	S3 470 nF	S2 220 nF	S1 100 nF	S0 51 nF
45007.7	x		x				
45004	x		x				
47679.9	x		x				
53993.1	x			x		x	x
57515.3	x			x		x	x
80515.1	x					x	
44544	x		x				
54046	x			x		x	x
58824	x			x			
60023	x			x			x
63953	x				x	x	
61090	x				x	x	x
49700	x			x	x		

5.4. Dynamic Focus

In order to get an optimal point concentration, a deflection related focus voltage is required. For that reason, the adjustable focus voltage is modulated by a H and V frequent parabola voltages. The H frequent parabola is formed with the transformer MA7/4 &5. The deflection current flows through the primary windings with a lower number of turns and the higher turns secondary winding is capacitively loaded with CA157. The result is a parabola wave form of about 700V peak to peak voltage. The vertical component is generated by amplifying the east-west parabola signal with TA23. These two voltages are added together and fed to the high voltage transformer pin MA1/11, from where it is brought to the focus voltage line through an internal capacitor.

6. Vertical Deflection and Geometric Corrections

6.1. Vertical Oscillator

ICA8 contains vertical oscillator in addition to the horizontal oscillator. The TTL level vertical sync pulses are fed to the pin ICA8/10. There is no need for separate normalizer because ICA8 has an inbuild polarity correction. The free-running frequency has been set to 42 Hz with RA57 (pin ICA8/15) and CA35 (pin ICA8/16). The output amplitude is frequency independent because the ICA8 has an internal amplitude control.

Differential current type output of the vertical oscillator has a maximum current drive capability of ca. ±0.5 mA. The oscillator output ICA8/5 & 6 is connected to the vertical output stage ICA16/1 & 7. The output current can be controlled with the current into the pin ICA8/13.

The height control signal to the pin ICA8/13 is taken from ICA11/3. A parabola voltage, necessary for the vertical S–correction, is fed to the ICA8/13 from pin ICA8/11 through RA56. The height drift caused by the east-west adjustment is compensated with RA48 and RA49.

6.2. Vertical Blanking Signal

The transistor circuit TA21/TA22 generates a blanking pulse with maximum length of 450 ms. This pulse is added to the blanking line through RA195 and forwarded together with the horizontal blanking pulses to G1 of the tube.

TA22 conducts between blanking pulses. The voltage on the base of TA21 is high, and the transistor is off. The circuit is triggered by the trailing edge of the vertical frequent pulses taken from pin ICA14/1. When the voltage on pin ICA14/1 goes down, TA21 gets some base current, which makes it conduct. Then the TA21 collector voltage goes high turning TA22 off. The collector of this transistor goes to –11V which gives more base current to TA21. The circuit stays in this condition until CA117 is charged through RA191 to the level of base–emitter threshold voltage of TA22. This re–establishes the start condition. The action is repeated when the next vertical pulse triggers the circuit.

6.3. Parabola Generator and East/West Correction

The ICA8 contains among others a parabola generator. Its amplitude is independent from the frequency and it can be adjusted by controlling the current into the pin ICA8/14. The maximum amplitude of the parabola wave is about 3.3 V peak to peak. The east/west correction has been implemented by modulating the pulse width of the picture width control with the vertical parabola. The parabola is added to the width control signal with TA10. This same parabola is also used to modulate the horizontal centring. This secures the east/west balance correction. Furthermore the parabola drives TA23 for the vertical dynamic focusing and modulates the vertical amplitude adjustment for the vertical S–correction

6.4. Ramp Generator and Trapezoidal Correction

The trapezoidal correction has been implemented by modulating the pulse width of the horizontal width control with a suitable signal through RA112. This vertical frequent ramp wave needed for the trapezoidal correction is generated in the integrator ICA13A. The circuit is triggered by the vertical frequent pulses fed to the analogue switch IC12/9. During the triggering pulse there is a connection between the pins ICA12/4 & 5. The integrator capacitor CA64 is charged and the output pin ICA13B/7 is clamped to the control voltage level occurring at the pin ICA13B/5. After triggering, CA64 begins to charge. If the control voltage is below the reference voltage of 5.0V at ICA13A/2, the pin ICA13A/1 sinks current from the CA64, the capacitor begins to charge and the voltage level at the pin ICA13B/7 begins to increase. The integrator capacitor CA64 will be charged until the next triggering pulse comes and recharges the capacitor. The output pin ICA13B/7 will be clamped back to the control voltage and the function starts from the beginning. If the control voltage is over the reference level, the pin ICA13B/1 sources current and the output wave form is opposite.

ICA13A is feedback amplifier. It tends to keep the DC level of the pin ICA13B/7 exactly the same as the reference level by adjusting the voltage level at pin ICA13B/1. If the DC level of the pin ICA13B/7 tries to decrease, in other words the ramp amplitude tries to decrease, the voltage level at the pin 1 decreases, CA64 charges faster and the peak value of the ramp wave form will become higher. The peak to peak amplitude of the output ramp is twice the difference between the control voltage and the reference level.

6.5. Orthogonal Correction

The orthogonal correction has been implemented by modulating the horizontal raster centring with a similar vertical frequent ramp wave forms as the trapezoidal correction ramp. Gates ICA13C & D together with ICA12 generates the ramp voltage. The working principle is the same as that of the trapezoidal correction. The ramp is fed to the base of TA24 through CA80

6.6. East/West Balance Correction

The east/west balance correction is realized also by modulating the current of TA24 with a suitable vertical frequent wave form. Now a vertical parabola wave is used instead of a ramp wave form. This parabola is taken from the pin ICA8/11 and is fed through the ICA15 to the base of TA24.

ICA15 is a DC–controlled attenuator. Positive parabola is brought to input pin ICA15/4 and negative parabola is brought to input pin ICA15/2. Depending on the direction of the needed correction the suitable input, positive or negative, is selected with pin ICA15/3 under processor control. If the pin ICA15/3 is low, input 4 is used and if high, input 2 is used. The output amplitude can be controlled by the DC voltage on the pin ICA15/6.

6.7. Tilt Correction

The tilt correction is implemented by feeding DC current through the tilt coil fixed to the deflection yoke. ICA20B together with TA46 and TA47 forms a current generator. The magnitude of the current can be controlled by shifting DC level on the pin ICA20B/5. The feedback is taken over the current sensing resistor RA266.

7. Vertical Deflection Output Stage

7.1. Amplifier

The vertical deflection output stage ICA16 is a conventional inverting operational amplifier (TDA8172). The vertical oscillator's saw-tooth wave current is applied to the pin ICA16/7 and the feedback is connected to ICA16/1 from the current sensing resistors RA137, RA138 and RA140.

7.2. Vertical Centring

Vertical centring is accomplished by changing the DC working point of the output amplifier. If the DC level is over or under the ground level, a DC current flows through the deflection yoke shifting the raster in vertical direction.

The working point can be adjusted by applying DC current to the input pin ICA16/7 through RA357 and to the pin 1 through RA133 and RA130. If the control voltage taken from the pin ICA21/12 is at the centre point (6V), the current through RA133 is equal to that in RA357. In this situation the DC level of the output pin ICA16/5 is 0V and the raster is not moved. If there is a difference in the currents, it must be compensated by DC component in the deflection yoke causing a vertical shift of the raster on the picture tube.

8. *High Voltage Generator*

8.1. Pulse Width Modulator

The high voltage regulation has the same operating principle as the picture width control, which uses a pulse width modulator and a switching circuit. The only difference is that the high voltage regulation uses the feedback from the high voltage transformer but the picture width follows the monitor keyboard setting.

8.2. Regulation of the High Voltage

The high voltage has an active regulator circuit, which makes it insensitive to beam current variations. The high voltage transformer's bleeder resistor provides feedback, which is compared to the error amplifier ICA17A reference voltage.

The output of the error amplifier controls the pulse width modulator to correct a possible error. The high voltage can be adjusted with RTA5. If the trimmer's resistance value is increased, the high voltage decreases and vice versa.

If the high voltage tends to decrease, the voltage on the error amplifier ICA17/2 also decreases and the output voltage on ICA17/1 increases. Increasing this voltage slows down the charging of the monostable's (ICA30) time constant capacitor CA112 through RA368 and TA65 and the width of the output pulse increases. The increasing pulse width increases the high voltage transformer's supply voltage, which rises the high voltage to the correct value.

8.3. Beam Current Limiter

The beam current limiter circuit TA15/TA20 monitors the voltage over CA105, which is inversely proportional to the beam current. This transistor feedback has been dimensioned so, that when the beam current exceeds ca. 550µA, the output of the transistors starts to limit the contrast and brightness control voltages to the video amplifier through the diodes DA70 and DA71. This limits the maximum beam current to ca. 700µA.

8.4. X–Ray Protection

For safety reasons, the anode voltage is limited to level recommended by picture tube manufacturer. The high voltage level is monitored by MA1/1 & 2. This winding generates a positive voltage proportional to the high voltage. The voltage is rectified and filtered with CA95. If the high voltage increases to about 31 kV, the voltage over CA95 increases to 9.7V which reaches the threshold voltage of DZA11 and TA68 b–e junction and TA68 begins to conduct. At the same time TA67, which is normally off, obtains a base current and turns on. The collector voltage on TA67 increases, which makes TA68 to conduct completely. and the collector voltage of TA67 remains at 12 volts. TA8 obtains a continuos base current from TA67 and cuts the drive of the switching transistor TA9. In this case, the high voltage generator is stopped and the high voltage goes to zero. The high voltage generator does not return before the monitor is switched off and on again.

9. Convergence Corrections

The picture tube has been fitted with both H and V direction convergence correction containing both factory and user adjustments. The vertical lines (H–convergence) are adjusted by shifting the DC-level of the tube's internal convergence plates. This has been obtained by a resistive voltage divider from the picture tube's anode. A coarse adjustment is made with the trimmer on the SMH board. Its lower end has been connected via QA2/13 to TA49 which forms a current generator with TA48. The current through the transistors and thus the voltage level of the convergence plates is controlled with the pin ICA21/16.

The static correction of the horizontal lines (V–convergence) is adjusted by feeding the DC current through the beam bender coil on the tube's neck. ICA20A together with TA45 form a current generator. The current magnitude can be adjusted by shifting the DC level of the pin ICA20/3. The feed back is taken over the current sensing resistor RA262. The dynamic correction has been implemented by modulating the current with a vertical frequent ramp. Both ends of the ramp can be separately adjusted with RTA3 and RTA4.

10. Processor

The processor unit's primary task is to identify the computer's display mode and select picture properties corresponding the detected display mode. The processor controls user and service adjustments, power management as well as commands the horizontal oscillator and the selection of S-capacitors.

Picture properties are stored in the EEPROM. Each display mode has two locations in the memory, one for values adjusted in factory and the other for user made adjustments.

Contrast, brightness, colour temperature selection, convergence, horizontal raster centring, RGB black level, RGB gain and G2 are common for all display modes. Other properties are separate for each display mode.

10.1. Architecture

The processor module contains CPU, program memory, non-volatile data memory, D/A converter and other command components as well as the control keyboard connection.

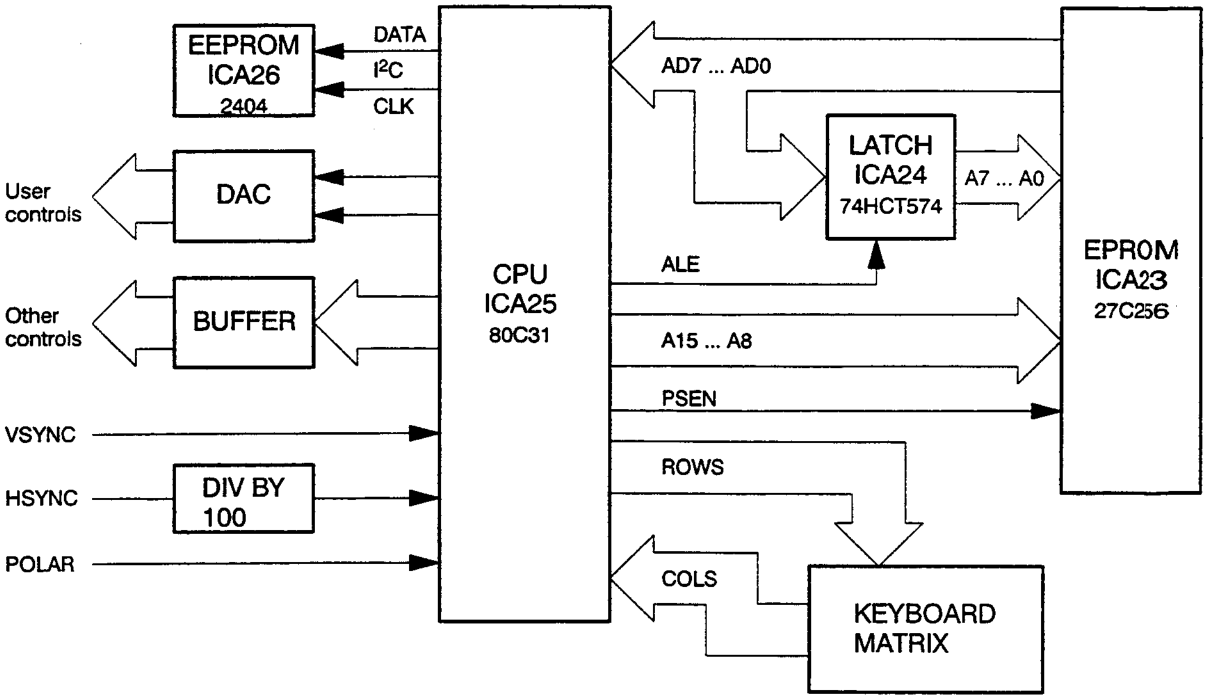

EEPROM
ICA26
2404
DATA
I²C
CLK
User controls
DAC
Other controls
BUFFER
VSYNC
HSYNC
DIV BY 100
POLAR
CPU
ICA25
80C31
AD7 ... AD0
LATCH
ICA24
74HCT574
A7 ... A0
ALE
A15 ... A8
PSEN
ROWS
COLS
KEYBOARD MATRIX
EPROM
ICA23
27C256

Figure 4 Processor Module

10.2. CPU

The system's control processor is an 8 bit CHMOS microprocessor 80C31, which has 128 bytes of data memory, 32 I/O lines divided in four 8 bit ports, two 16 bit timers and UART.

Processor's clock frequency is formed using an external 12 MHz crystal. The circuit's reset is secured by a comparator.

The 0 port is used to form a multiplexed address and data bus (A7 ... A0 and D7 ... D0).

Port 2 contains the higher address lines A15 ... A8.

Ports 1 and 3 contain general purpose I/O lines, which are used to build the I²C bus (serial data and clock), to receive the monitor's timing signals, to control power management circuits and to keyboard scanning. WR and RD lines are used to transmit the data to other circuits.

10.3. Program Memory

The 256K x 8 bit CMOS EPROM (27C256) is used as the program memory ICA23. The program memory's data lines are connected directly to the CPU's multiplexed address and data bus. The lower address lines A7 ... A0 are separated from the multiplexed bus by using the CPU generated ALE pulse into the latch ICA24 (74HCT574).
The higher address lines A14 ... A8 are connected directly to the CPU's address bus (A15 is unused). The CPU generated PSEN line is used as the program memory's read signal.

TA59 cuts the voltage from ICA23 and ensures that the memory stays in start-up condition.

10.4. Non-volatile Data Memory

I²C bus compatible 512K X 8 bit EEPROM is used as non-volatile data memory ICA26 for the system. The CPU writes and reads data from EEPROM through the I²C bus.

The memory contains picture properties for each display mode. Factory adjusted data is stored in the write protected part of the memory. Write protection is achieved by connecting the pin ICA26/7 to V_{CC}. During write enable the pin is forced to GND.

10.5. Keypad Connection

The row data is written to the latch ICA22 (74HCT574). The column lines of the key matrix are connected to the CPU input lines 5 ... 8. The CPU scans the key matrix by pulling down subsequently each row line and by monitoring the state of the column lines. GND is detected on the column line if the button in this row/column crossing is pushed down.

10.6. Monitor's Timing Signals

The CPU selects picture properties from memory location which is named for the detected timings. Several timing periods are checked before any change is made in display mode.

Vertical timing signal is fed directly to the CPU's input line ICA25/4. The horizontal timing signal, divided by 100 in ICA6, is brought to the CPU's interrupt input line ICA25/12. The divider ICA6 (74LS390) contains two by 2 dividers and two by 5 dividers. The CPU detects the polarity of the vertical sync pulses in addition to the timings.

10.7. D/A Converter

The D/A converters are used to change the digital information stored in the memory locations into analog voltage. One converter controls line oscillator with voltage proportional to the frequency.

The CPU writes the data into the D/A circuits ICA11, ICH2 and ICA21 through the I²C bus. The data is written to the D/A converter ICA11 with LOAD pulse from CPU (ICA25/14).
ICA11 (M62352) with 5 V operating voltage has twelve 8 bit converters. ICH2 and ICA21 are both working with 12 V and have eight 6 bit converters.

10.8. S-capacitor and Linearity Coil

The wave form of the deflection current is corrected with S-correction capacitor and linearity coil. There are six capacitors and two linearity coils. Depending on the display mode, CPU selects the most suitable S-capacitor and linearity coil.
The combination of S-capacitor and linearity coil is stored to the latch ICA27 (74HCT574) with WR pulse. The levels of these drive lines are shifted from the TTL level to 0 −12 V level with TA52 – TA58.

10.9. Black Level Locking

The pin ICA25/15 controls the moment of time when the black level information is read from the video signal. There are two possibilities: during sync pulse or during back porch.

10.10. Power Management

The micro processor circuit ICA25 accomplishes a power management logic according to the VESA standard. The processor tracks the incoming sync pulses and determines the actual functional mode. The control for other electronic circuits is obtained by shifting the state at the pins ICA25/3 and 13.

State	**Horizontal sync**	**Vertical sync**	**Logic Voltage at pin**	
			ICA25/3	**ICA25/13**
Power OFF	–	–	1	1
Normal	Yes	Yes	1	1
Stand-by	No	Yes	1	1
Suspend	Yes	No	0	1
Power down	No	No	0	0

10.11. Degauss

When the degaussing button in the keypad is pushed down, CPU generates 2s pulse to the pin ICA22/12.

10.12. Program

During start-up the processor detects the display mode and reads the values for picture properties from the EEPROM. After this the processor scans the buttons and checks the timings of current display mode. If any change is found in the timing signals, new values related to the new display mode are read from the EEPROM.

In case the timing signals are missing partly or totally, the processor starts a power management procedure. If there are no timing signals during start-up, the power management procedure is inhibited and a white raster appears on the screen.

If a button is pushed down, the processor performs the corresponding adjustment or change in settings of the monitor. In case of adjustment the new value will be stored automatically after the adjustment.

11. Video Amplifier

The video amplifier is designed to drive a 17 inch picture tube with less than 150 MHz dot frequency.

The video amplifier is formed by a three channel preamplifier, three output amplifiers, three black level adjustment and clamping circuits, a brightness adjustment circuit and a separator circuit for the G-sync signal. The video amplifier's properties are affected via I^2C bus.

The channels R, G and B are similar in operation. The block where the component belongs can be judged from the first number in component identifier

1xx R–channel
2xx G–channel
3xx B–channel
xx Common circuits

11.1. Preamplifier

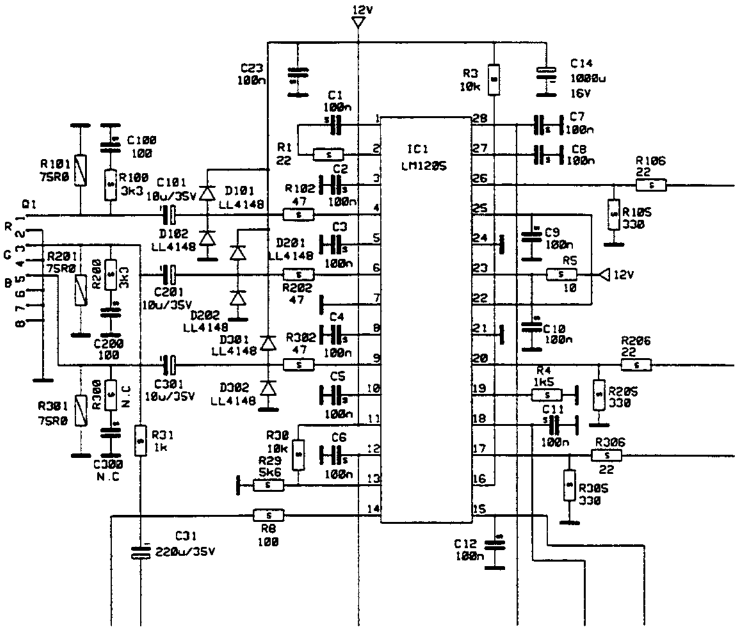
National Semiconductor's LM1205 IC with 130 MHz band width is used as preamplifier. The preamplifier contains an input amplifier, a contrast regulation stage, a keyed black level clamping circuit, an adjustable amplifier stage and an output circuit. The circuit uses 12V supply voltage.

The video signals, which are terminated to 75 ohm, are fed trough the coupling capacitors CH101, CH201 and CH301 to ICH1/4, 6 & 9. The input pins are biased to 2,4 V through an internal reference voltage.

The pin ICH1/12 receives the contrast adjusting voltage, which can be adjusted to 1 ... 4 V. The contrast adjusting voltage adjusts the three channels' amplification in equal proportions in order to keep the color tint constant with different contrast levels.

The pin ICH1/14 receive a negative polarity black level clamping pulse, which arrives either during the back porch (back porch clamping) or during the sync pulse (sync tip clamping). The clamping pulse's width is 550...1000 ns with increased width for lower line frequency. During the clamping, the circuit compares the output's DC level to the adjusted reference level and rectifies the output's DC level correctly using internal comparators. The reference voltage, which is formed with RH3 and RH4, is applied to the pins ICH1/16, 19 & 27.

The amplification of each channel can be controlled by DC level through the pins ICH1/15, 18 & 28. The adjustment voltages are obtained from pins ICH2/14, 15 & 16, which is followed by an internal resistive divider attenuating the control voltage to 0...4 V. The picture's colour balance can be adjusted correctly with the amplification adjustments. The circuit's output pins 17, 20 and 26 generate output signals with amplitudes of about 2.5 V when the contrast is in maximum and the DC levels about 1.5 V.



12V
C23 100n
C1 100n
R1 22
C2 100n
R102 47
C3 100n
D201 LL4148
R202 47
C4 100n
R302 47
C5 100n
R30 10k
R29 5k6
C6 100n
R8 100
C31 220u/35V
C100 100
R101 75R0
R100 3k3
C101 10u/35V
D101 LL4148
D102 LL4148
Q1
R G B
1 2 3 4 5 6 7 8
R201 75R0
R200 3k3
C200 100
C201 10u/35V
D202 LL4148
D301 LL4148
D302 LL4148
C301 10u/35V
R301 75R0
R300 N.C
C300 N.C
R31 1k
IC1 LM1205
R3 10k
C14 1000u 16V
C7 100n
C8 100n
R106 22
R105 330
C9 100n
R5 10
12V
C10 100n
R206 22
R4 1k5
R205 330
C11 100n
R306 22
R305 330
C12 100n

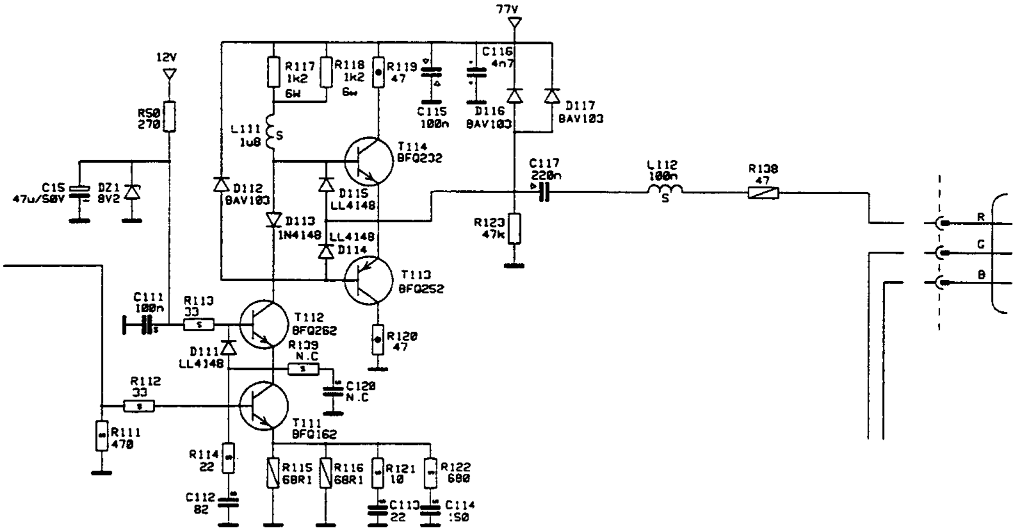
Video Preamplifier

11.2. Output Stage

Each output stage is an active load stage cascade amplifier with a voltage amplification factor of about 17 (25 dB). The output stage's input is DC coupled, which means that the preamplifier's output biases the output stage so that the voltage corresponding to black level at the output stage's output is about 65 V. The output stage has a supply voltage of 74V.

The video signal is brought to the base of TH111 from the preamplifier ICH1. The collector current of TH111 drives the emitter of TH112. The working point of TH111 is determined by 8V DC voltage at output transistor's base, DC feed-back resistors RH115 and RH116 and the input's DC level. The output transistor's collector current, which depends on the input signal's amplitude, is transformed to voltage loss over the collector resistors RH117 and RH118. The serial connected peaking coil gives a greater amplification for higher frequencies. The RC circuit on the drive transistor's emitter shapes the pulse response. The RC circuit on the output stage's emitter improves the output stage's stability.

The active charge stage is formed by TH113 and TH114. The active charge stage separates the tube's cathode capacitance of about 5 pF from the output stage's collector and diminishes the cathode capacitance's charging and discharging impedance. This improves the output stage's ability to drive a capacitive load at higher frequencies. The active charge stage's bias current is set by DH113 and RH123 so that there is no bias current through TH114 and the bias current trough TH113 is about 1.3 mA. TH113 and TH114 produce an approximately 40V video signal, which is fed trough coupling capacitor CH117, peaking coil LH112 and a protector resistance RH138 to the picture tube's cathode.


77V
12V
R117 1k2 6W
R118 1k2 6W
R119 47
C116 4n7
C115 100n
D116 BAV103
D117 BAV103
R50 270
L111 1u8
S
T114 BFQ232
C15 47u/50V
DZ1 8V2
D112 BAV103
D115 LL4148
D113 1N4148
LL4148 D114
C117 220n
L112 100n
S
R138 47
R123 47k
T113 BFQ252
R
G
B
C111 100n
R113 33
T112 BFQ262
R139 N.C
D111 LL4148
R120 47
C120 N.C
R112 33
R111 470
T111 BFQ162
R114 22
C112 82
R115 68R1
R116 68R1
R121 10
R122 680
C113 22
C114 150

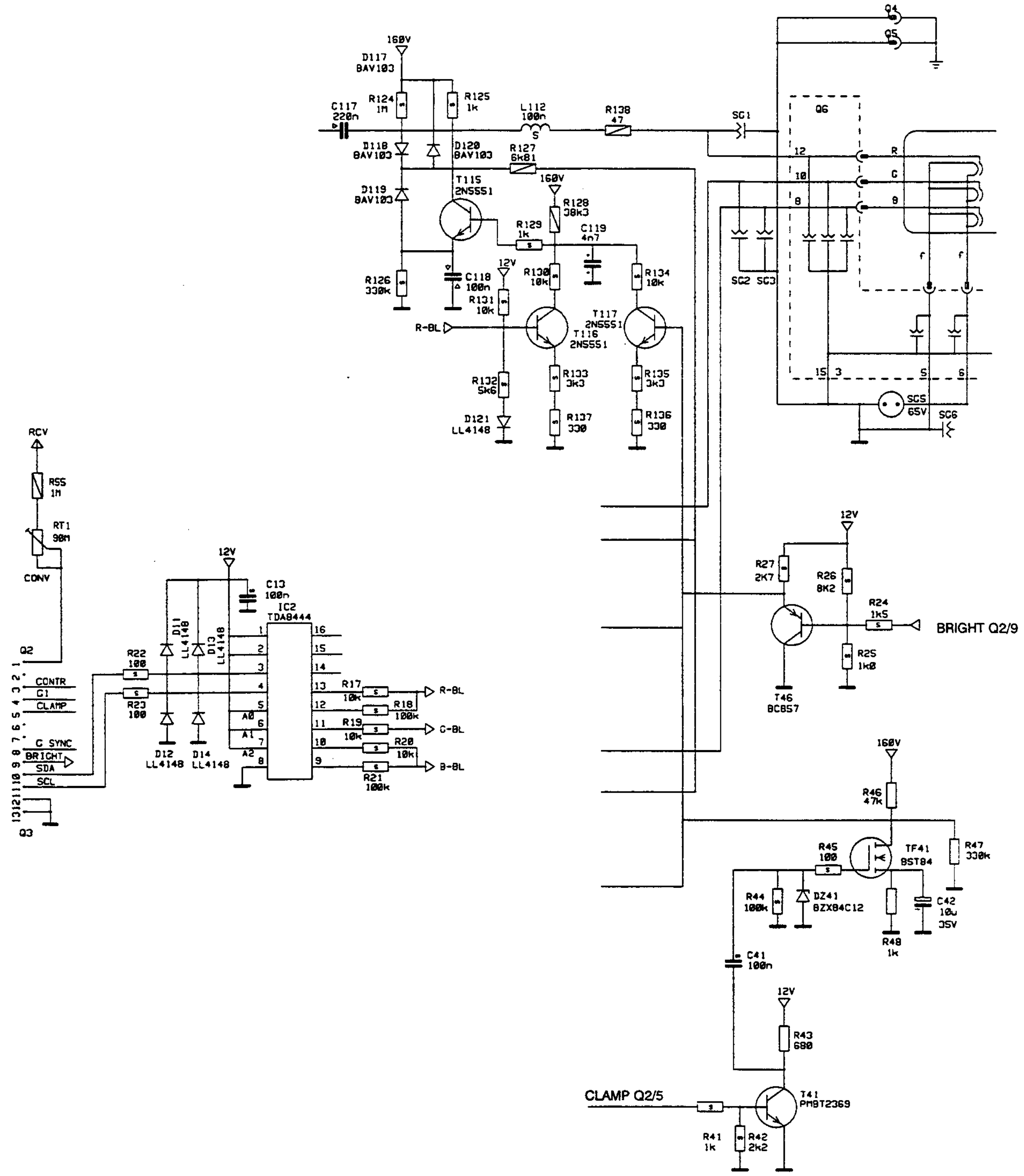
Video Output Amplifier

11.3. Black Level Clamping and Black Level Adjustment Circuit

After the passage through the coupling capacitors CH117, CH217 and CH317 the black levels of the video signals must be adjusted by each channel so that the mutual background (frame) colour balance is correct. A diode clamping is used as black level clamping method.

The negative polarity clamping pulse is fed to TH41's base. The transistor's collector gives a positive pulse which is applied to TFH41 grid. The FET produces a pulse, which makes the diodes DH118 and DH119 conductive so that the black level voltage on the cathode corresponds the transistors TH115 emitter voltage.

The cathodes' black level adjustments are made trough the I^2C bus and the adjustment voltages are obtained from DAC circuit's (ICH2) pins 12 and 13. The adjustment voltages are added with the resistances RH17 and RH18; the adjustment voltage at the pin 12 works as fine adjustment and the voltage at the pin 13 as coarse adjustment. The adjustment voltage is fed to the current generator transistor TH116 base. The TH116 collector current adjustment changes the base voltage of TH115, which is buffered by TH117. The black level voltage can be adjusted to 80 ...105 V.


160V
D117
BAV103
C117
220n
R124
1M
R125
1k
L112
100n
R138
47
SC1
Q4
Q5
Q6
D118
BAV103
D120
BAV103
R127
6k81
T115
2N5551
160V
D119
BAV103
R128
38k3
R129
1k
C119
4n7
R126
330k
C118
100n
12V
R130
10k
R131
10k
R134
10k
T117
2N5551
T116
2N5551
R-BL
R132
5k6
R133
3k3
R135
3k3
D121
LL4148
R137
330
R136
330
12
10
8
R
G
B
f
f
SG2
SG3
15
3
5
6
SG5
65V
SG6
RCV
R55
1M
RT1
90M
CONV
Q2
CONTR
C1
CLAMP
C SYNC
BRIGHT
SDA
SCL
Q3
12V
C13
100n
IC2
TDA8444
D11
LL4148
D13
LL4148
R22
100
R23
100
D12
LL4148
D14
LL4148
A0
A1
A2
R17
10k
R18
100k
R19
10k
R20
10k
R21
100k
R-BL
G-BL
B-BL
12V
R27
2K7
R26
8K2
R24
1K5
R25
1K0
BRIGHT Q2/9
T46
BC857
160V
R46
47k
R45
100
TF41
BST84
R47
330k
R44
100k
DZ41
BZX84C12
C42
10u
35V
R48
1k
C41
100n
12V
R43
680
CLAMP Q2/5
T41
PMBT2369
R41
1k
R42
2k2

Black Level Clamping and Brightness Adjustment Circuits

11.4. Brightness Adjustment Circuit

The brightness adjustment adjusts the cathodes' black level voltages trough the black level adjustment circuits weighted with the channel's typical amplitudes, which gives a correct colour temperature with different brightness levels.

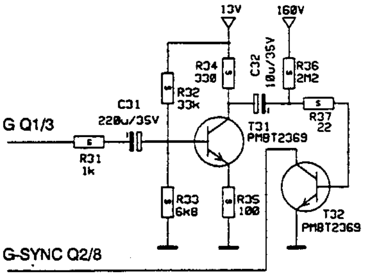
The transistors TH117/TH217/TH317 and TH46 form the brightness control circuit. TH46 is common for all channels (R, G & B). The brightness control voltage adjusts the black level voltage on the emitter of clamping transistor (T115/T215/T315) via T47 and T117/T217/T317.

11.5. Static Convergence

Trimmer RTH1 is used to adjust static convergence.

11.6. G-sync Separator

The sync pulse is separated in the G channel with TH31 and TH32. The transistor TH31's base gets a video signal with sync pulses. The signal is amplified by three after which it is fed to the transistor TH32's base through the coupling capacitor CH32. TH32 conducts during the positive sync pulses and the obtained sync pulse is fed to the connector QH4/4.

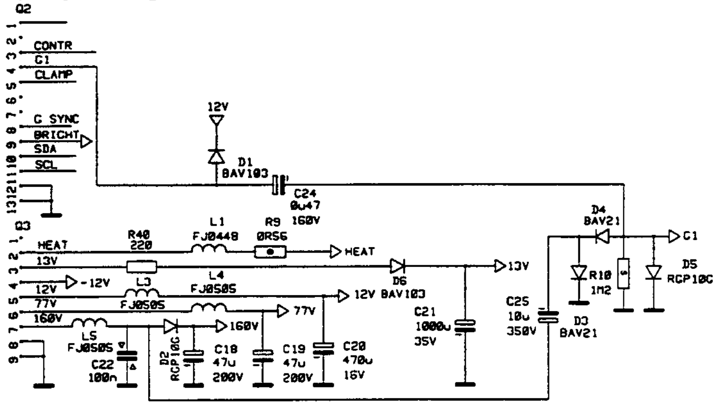

13V
160V
R34
330
C32
10u/35V
R36
2M2
R32
33k
C31
220u/35V
R37
22
G Q1/3
T31
PMBT2369
R31
1k
R33
6k8
R35
100
T32
PMBT2369
G-SYNC Q2/8

G-sync Separation

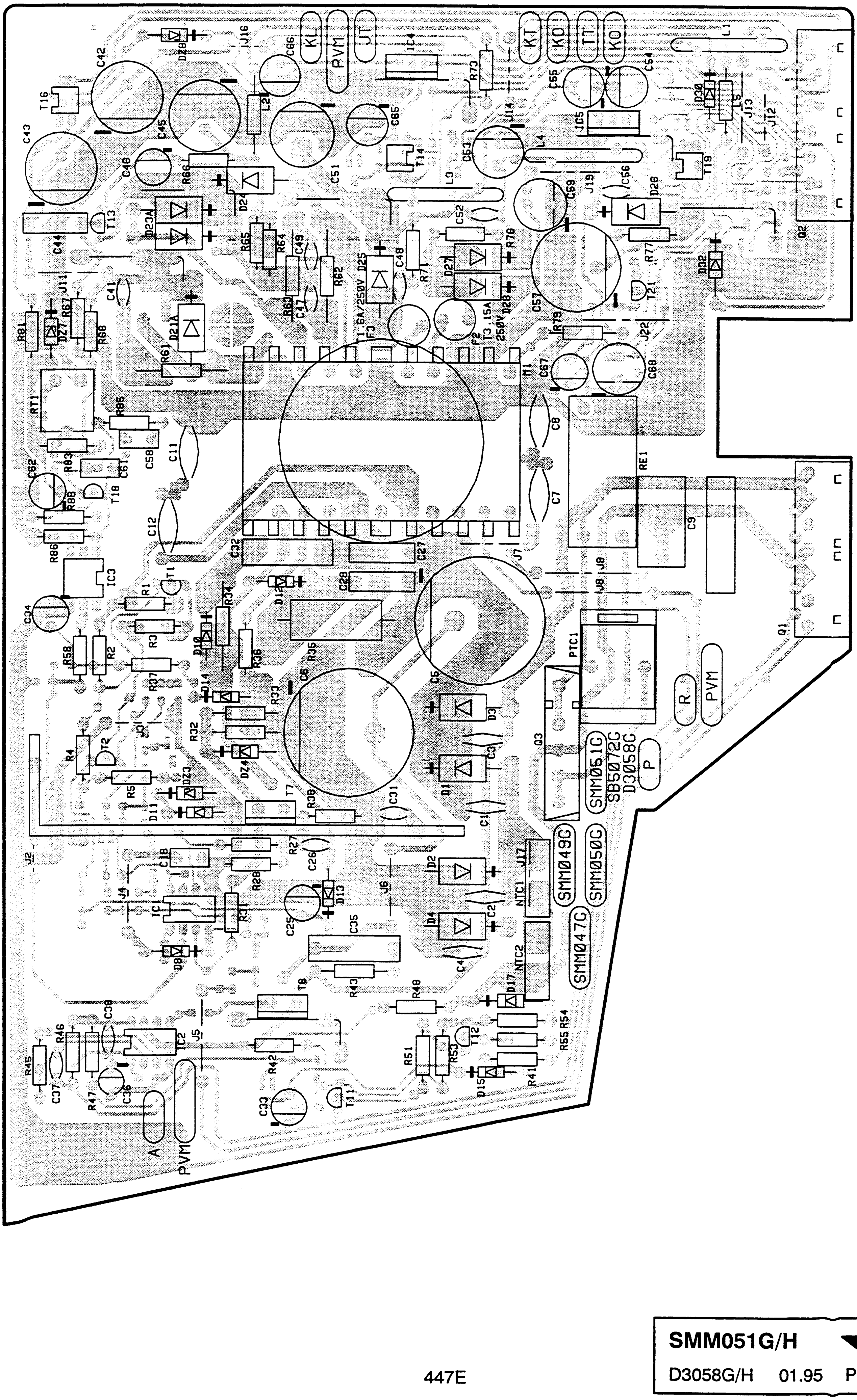
11.7. Blanking and Spot Killer

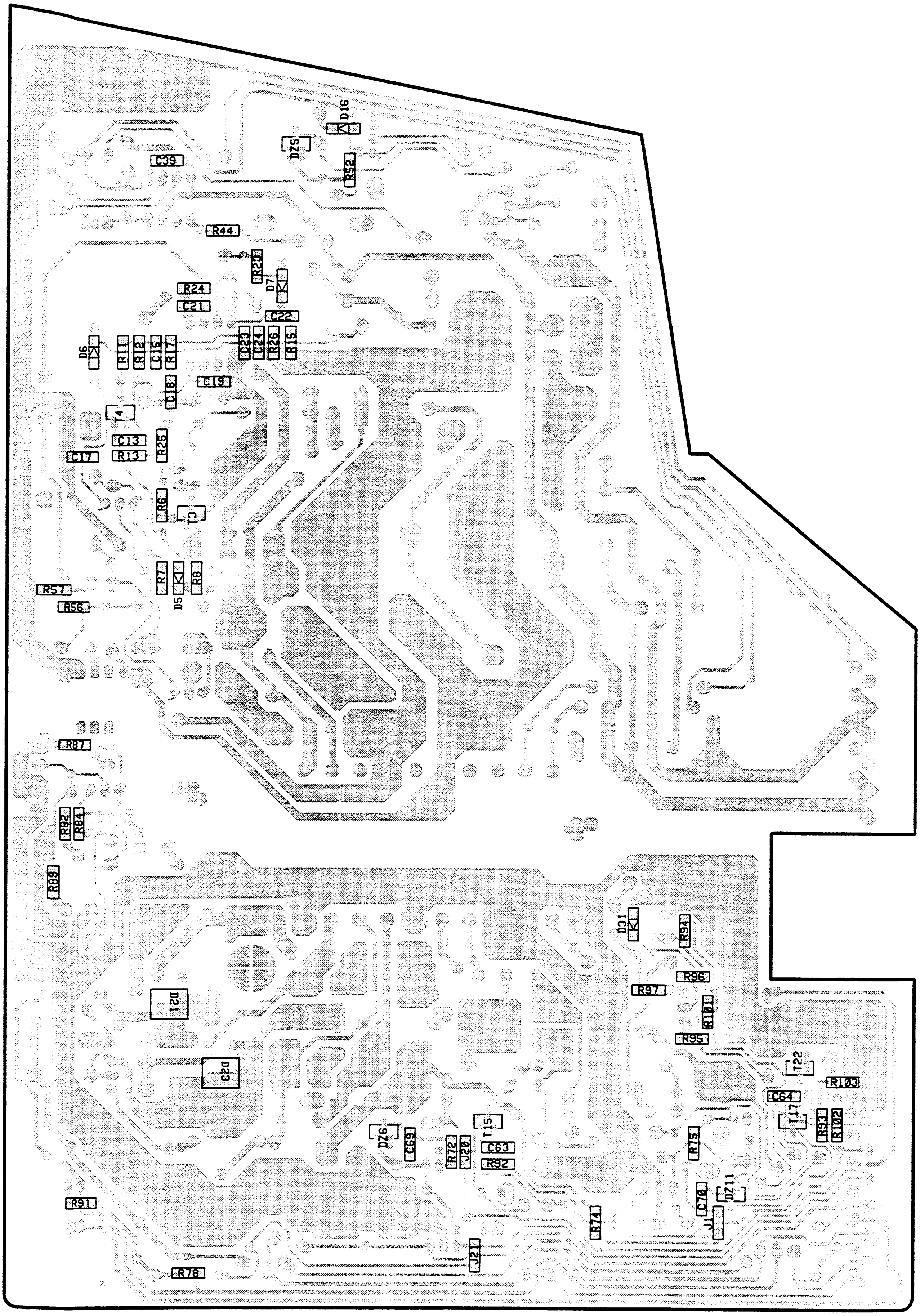
Blanking during vertical and horizontal fly back is made by applying negative blanking pulses to grid G1 (vertical: −20 V, horizontal: −90 V). During sweep the voltage at G1 is connected to GND through DH5.

The components CH25 and DH2 form a spot killer circuit. When the monitor is switched off, CH25 discharges via DH4 to G1 causing the G1 voltage to go negative. When the monitor is switched on, CH25 is charged rapidly through DH3.


Q2
1
2
3
4
5
6
7
8
9
10
11
12
13
CONTR
G1
CLAMP
G SYNC
BRIGHT
SDA
SCL
12V
D1
BAV103
C24
0u47
160V
Q3
1
2
3
4
5
6
7
8
9
HEAT
13V
12V
77V
160V
-12V
R40
220
L1
FJ0448
R9
0R56
HEAT
L3
FJ0505
L4
FJ0505
12V
77V
160V
L5
FJ0505
C22
100n
D2
RGP10C
C18
47u
200V
C19
47u
200V
C20
470u
16V
D6
BAV103
13V
C21
1000u
35V
C25
10u
350V
D3
BAV21
D4
BAV21
G1
R10
1M2
D5
RGP10C

Blanking and Spot Killer


KL
PVM
JT
KT
KO
TT
KO
T1.6A/250V
F3
T3.15A
250V
F2
M1
RE1
PTC1
Q1
Q2
Q3
R
PVM
P
SMM051G
SB5072C
D3058C
SMM049G
SMM050G
SMM047G
NTC1
NTC2
A
PVM


D16
DZ5
C39
R52
R44
R20
D7
R24
C21
C22
D6
R11
R12
C15
R17
C23
C24
R26
R15
C19
C16
T4
C13
R25
C17
R13
R6
T3
R7
D5
R8
R57
R56
R87
R92
R84
R89
D31
R94
R96
R97
R101
D21
R95
T22
D23
R103
C64
T17
R93
R102
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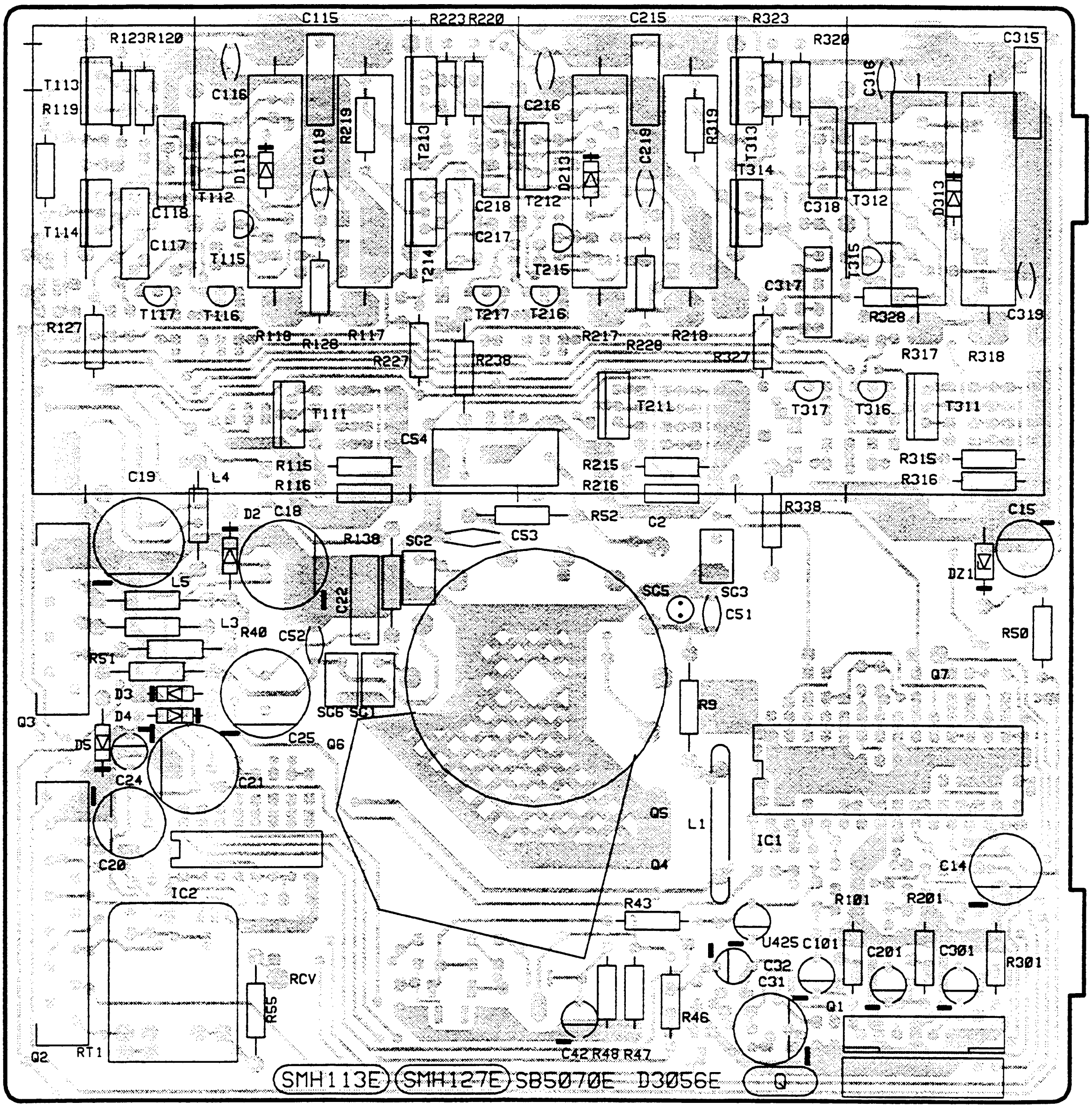
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R223 R220
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R119
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D113
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C216
D213
C219
R319
T313
C316
D313
T314
T112
C118
T114
C117
T115
C218
T212
C217
T214
T215
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T217
T216
R328
C319
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R217
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R317
R318
T111
T211
T317
T316
T311
C54
C19
L4
R115
R116
R215
R216
R315
R316
D2
C18
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SG2
C53
R52
C2
R338
C15
DZ1
L5
C22
SG5
SG3
C51
L3
R40
C52
R50
R51
D3
D4
SG6
SG1
R9
Q7
Q3
D5
C25
Q6
C24
C21
Q5
L1
IC1
C20
Q4
C14
IC2
R43
R101
R201
U425
C101
C201
C301
R301
C32
C31
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C42 R48 R47
SMH113E
SMH127E
SB5070E
D3056E
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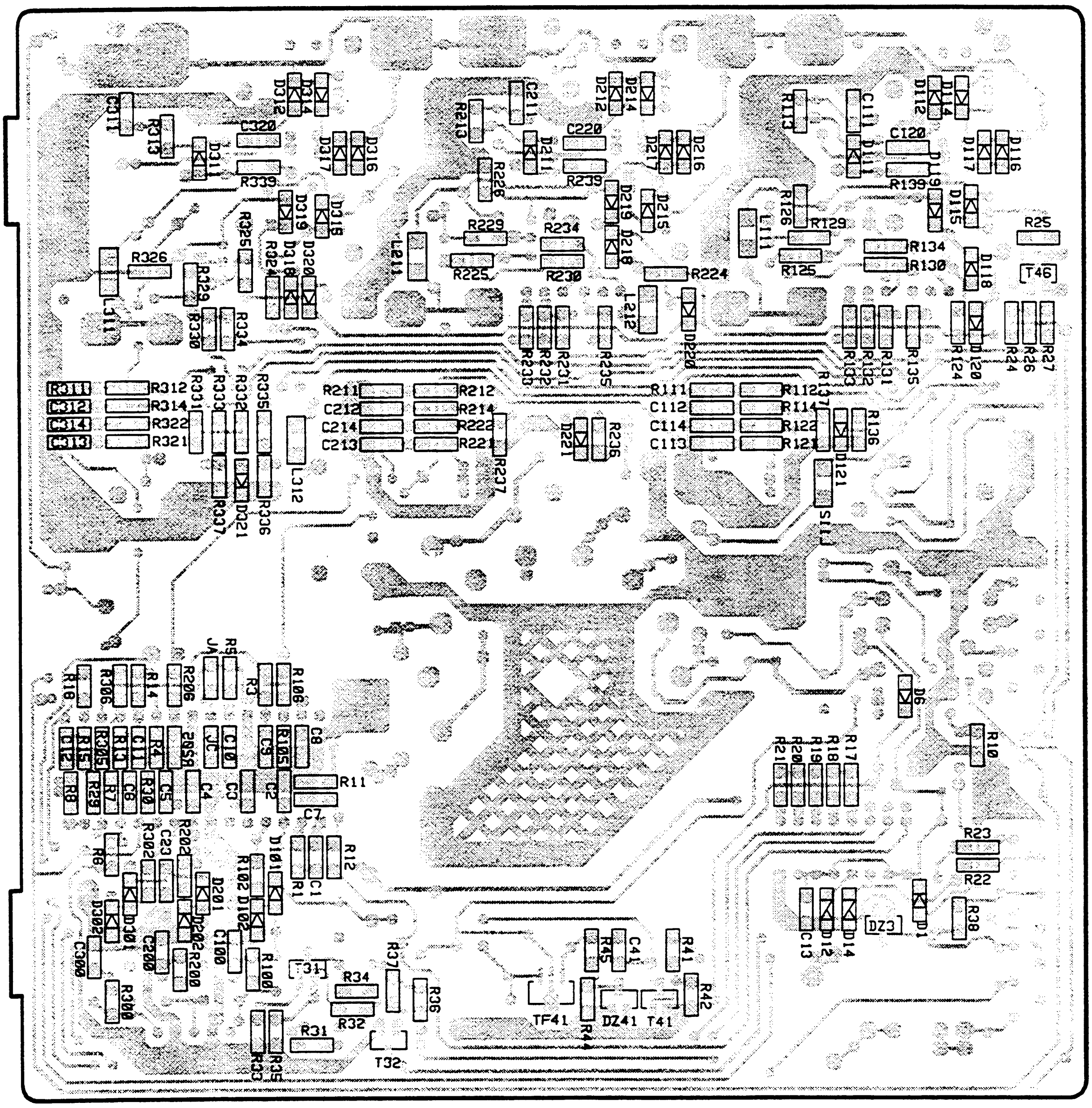

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D316
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D319
D318
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R326
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R322
C313
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R335
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D321
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D211
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C220
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D212
D214
D216
D217
D219
D215
D218
L211
R229
R234
R225
R230
R224
L212
D220
R233
R232
R231
R235
R211
R212
C212
R214
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R222
C213
R221
D221
R236
R237
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D111
C120
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D112
D114
D116
D117
D119
D115
R126
R129
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R125
R134
R130
R25
T46
D118
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C114
R122
C113
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R136
D121
L115
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R132
R131
R135
R124
D120
R24
R26
R27
R16
R306
R14
R206
JA
R5
R3
R106
C12
R15
R305
R13
C11
R4
R205
JC
C10
C9
R105
C8
R8
R29
R7
C6
R30
C5
C4
C3
C2
R11
C7
R6
R302
C23
R204
R102
D101
R1
C1
R12
D201
D102
D302
D301
D202
C300
C200
R200
C100
R100
T31
R37
R34
R36
R300
R32
R31
R33
R35
T32
D6
R10
R21
R20
R19
R18
R17
R23
R22
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DZ3
D1
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R45
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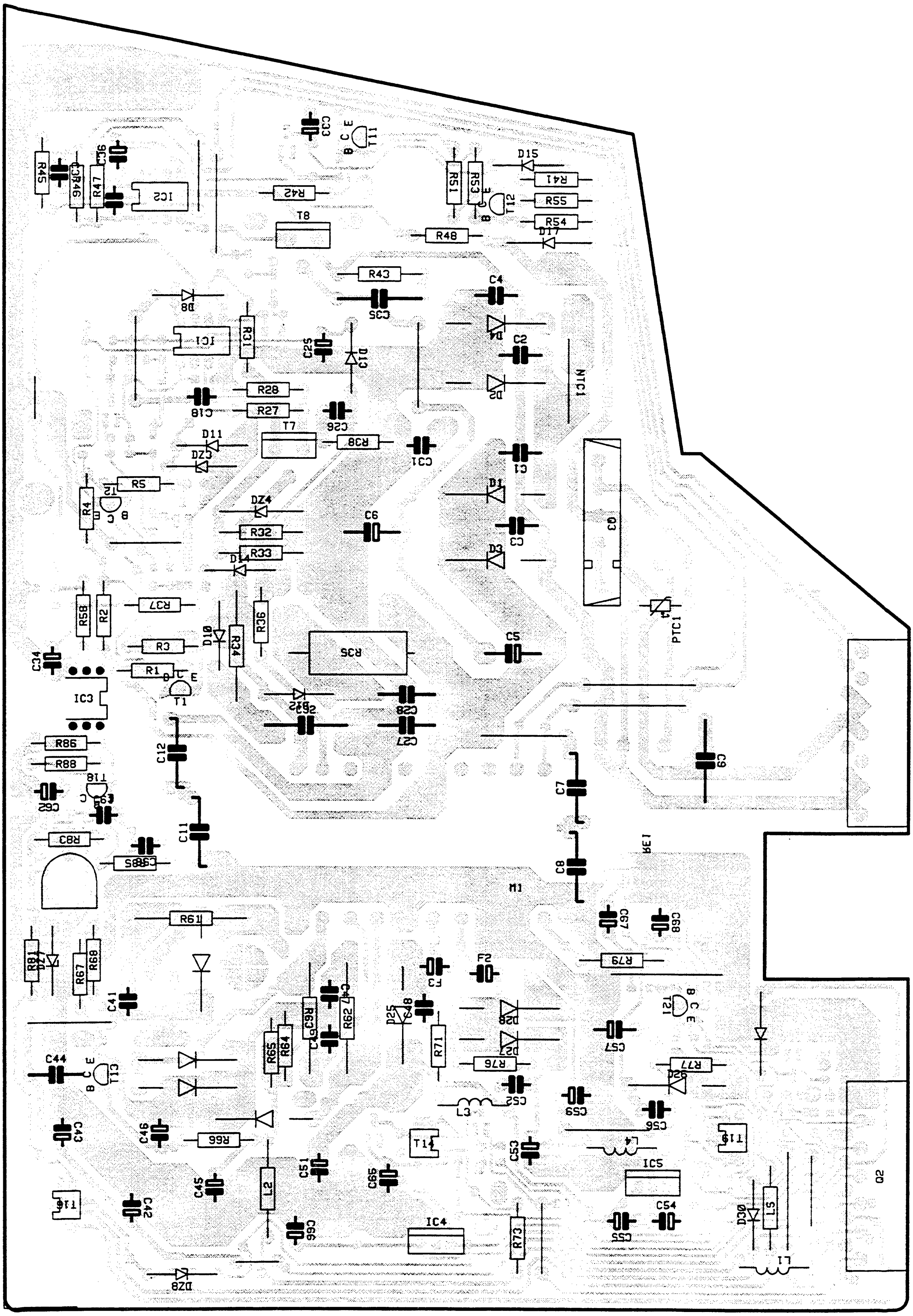
R41
R42
TF41
R4
DZ41
T41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B C E
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C36
R46
R47
IC2
R42
R51
R53
D15
R41
T12
R55
R54
R48
D17
T8
R43
C4
D8
C35
R31
IC1
C25
D4
C2
D2
NTC1
R28
C18
R27
C26
T7
R38
C31
C1
D11
DZ3
R5
T2
R4
D1
DZ4
C6
R32
C3
R33
D14
D3
Q3
R58
R2
R37
R36
PTC1
D10
R34
C34
R3
R35
C5
R1
T1
IC3
D12
C29
C28
C27
R86
R88
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T18
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C8
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C67
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R81
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F3
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R62
D25
C48
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IC5
Q2
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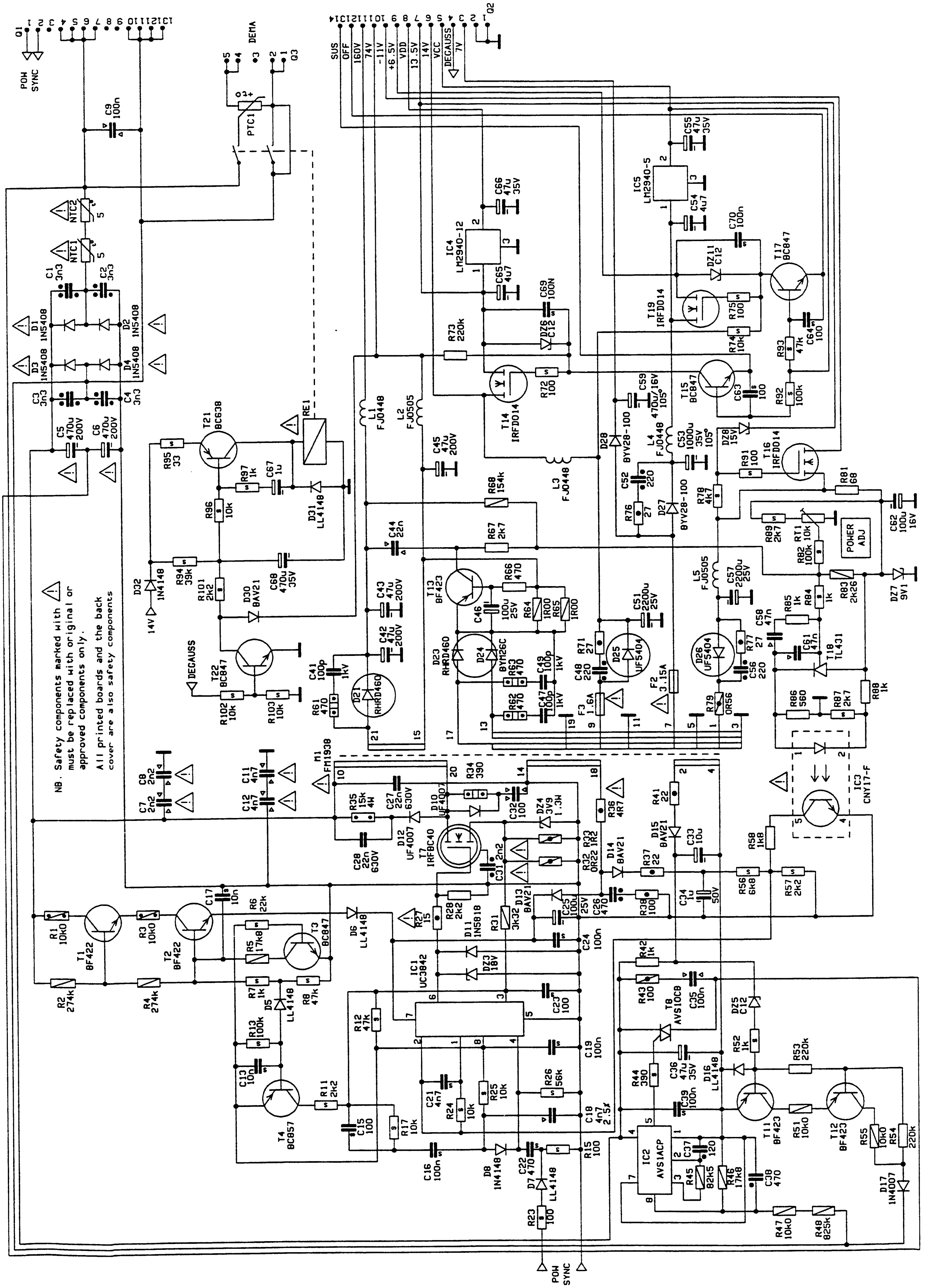
IC4
R73
C55
D30
L5
L1
DZ8



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Q3
DEMA
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NTC1
NTC2
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C2 3n3
C3 3n3
C4 3n3
D1 1N5408
D2 1N5408
D3 1N5408
D4 1N5408
C5 470u 200V
C6 470u 200V
C7 2n2
C8 2n2
C9 100n
C11 4n7
C12 4n7
RE1
T21 BC638
R95 33
R97 1k
C67 1u
D31 LL4148
R96 10k
R94 39k
C68 470u 35V
R101 2k2
D30 BAV21
D32 1N4148
14V
DEGAUSS
T22 BC847
R102 10k
R103 10k
SUS
OFF
160V
74V
-11V
+6.5V
VDD
13.5V
14V
VCC
DEGAUSS
7V
IC4 LM2940-12
IC5 LM2940-5
C66 47u 35V
C65 4u7
C69 100N
C55 47u 35V
C54 4u7
C70 100n
DZ6 C12
DZ11 C12
T14 IRFD014
T19 IRFD014
T16 IRFD014
T15 BC847
T17 BC847
R72 100
R73 220k
R74 10k
R75 100
R93 47k
C64 100
R92 100k
C63 100
L1 FJ0448
L2 FJ0505
L3 FJ0448
L4 FJ0448
L5 FJ0505
C45 47u 200V
C59 470u/16V 105°
C53 1000u 35V 105°
D28 BYV28-100
D27 BYV28-100
C52 220
R76 27
DZ8 15V
R91 100
R78 4k7
R81 68
C62 100u 16V
R89 2k7
RT1 10k
R82 100k
POWER ADJ
R68 154k
R67 2k7
C44 22n
T13 BF423
R66 470
C46 100u 25V
R64 1R00
R65 1R00
C43 47u 200V
C42 47u 200V
C41 100p 1kV
R61 470
D21 RHRD460
D23 RHRD460
D24 BYM26C
R63 470
R62 470
C49 100p 1kV
C47 100p 1kV
C48 220
R71 27
D25 UF5404
C51 2200u 25V
F3 1.6A
F2 3.15A
C57 2200u 25V
D26 UF5404
R77 27
C56 220
R79 0R56
C58 47n
R85 1k
R84 1k
R83 2k26
DZ7 9V1
C61 47n
T18 TL431
R86 560
R87 2k7
R88 1k
IC3 CNY17-F
R58 1k8
R56 6k8
R57 2k2
M1 FM1938
R35 15k 4W
C27 22n 630V
C28 22n 630V
D10 UF4007
D12 UF4007
R34 390
C32 100
DZ4 3V9 1.3W
T7 IRFBC40
C31 2n2
R33 1R2
R32 0R22
R36 4R7
R41 22
D15 BAV21
C33 10u
D14 BAV21
R37 22
C34 1u 50V
R38 100
C26 470
C25 100u 25V
D13 BAV21
R31 3k32
R28 2k2
R27 15
D11 1N5818
DZ3 18V
C24 100n
C23 100
C17 10n
R6 22k
T3 BC847
R5 17k8
R1 10k0
R2 274k
T1 BF422
R3 10k0
R4 274k
T2 BF422
R7 1k
R8 47k
D5 LL4148
D6 LL4148
R13 100k
C13 10n
T4 BC857
R11 2k2
C15 100
R17 10k
R12 47k
IC1 UC3842
C19 100n
R26 56k
C18 4n7 2.5%
C21 4n7
R24 10k
R25 10k
C16 100n
D8 1N4148
C22 470
D7 LL4148
R15 100
R23 100
R42 1k
R43 100
C35 100n
T8 AVS10CB
DZ5 C12
R52 1k
R53 220k
R44 390
C36 47u 35V
D16 LL4148
C39 100n
T11 BF423
T12 BF423
R51 10k0
R55 10k0
R54 220k
IC2 AVS1ACP
C37 120
R45 82k5
R46 17k8
C38 470
D17 1N4007
R47 10k0
R48 825k

NB. Safety components marked with △ must be replaced with original or approved components only.
All printed boards and the back cover are also safety components.

SMM051J

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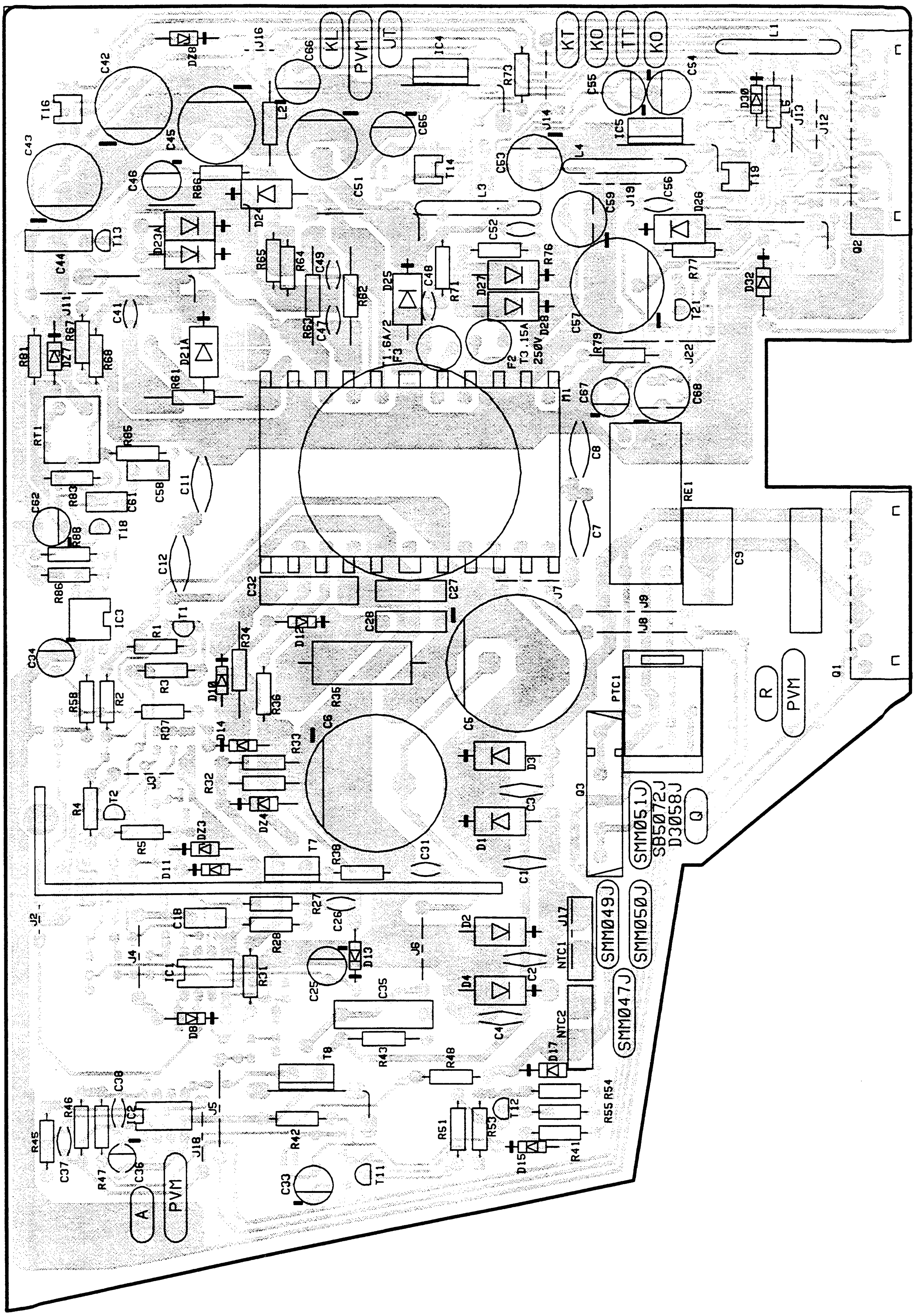
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PVM
UT
KT
KO
TT
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J16
DZ8
C42
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IC4
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D30
L5
J13
J12
T16
C21
C45
C65
J14
IC5
C43
C46
R66
D24
C51
T14
C53
L4
T19
L3
C59
J19
C56
D26
C44
T13
D23A
R65
R64
C49
R62
D25
C48
R71
C52
R76
D27
D28
R77
Q2
C57
T21
D32
J11
C41
R63
C47
1.6A/2
F3
F2
T3.15A
250V
R79
J22
R81
DZ7
R67
R68
D21A
R61
M1
C67
C68
RT1
R85
C58
C11
C8
R83
C61
RE1
C62
R88
T18
C7
C9
R86
C12
C32
C27
J7
J9
IC3
T1
C28
D12
J8
C34
R1
R34
R3
D10
R36
R35
Q1
R58
R2
R37
R
PVM
PTC1
D14
R33
C6
C5
D3
J3
R32
Q3
SMM051J
SB5072J
D3058J
Q
R4
T2
DZ4
C3
R5
DZ3
D1
D11
T7
R30
C31
C1
J2
C18
R27
C26
R28
D2
J17
SMM049J
SMM050J
J4
IC1
R31
D13
J6
NTC1
C25
C35
D4
C2
SMM047J
D8
C4
NTC2
R43
T8
R48
D17
C38
R46
C2
J5
R54
R55
T12
R45
R42
R51
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C33
T11
A
PVM

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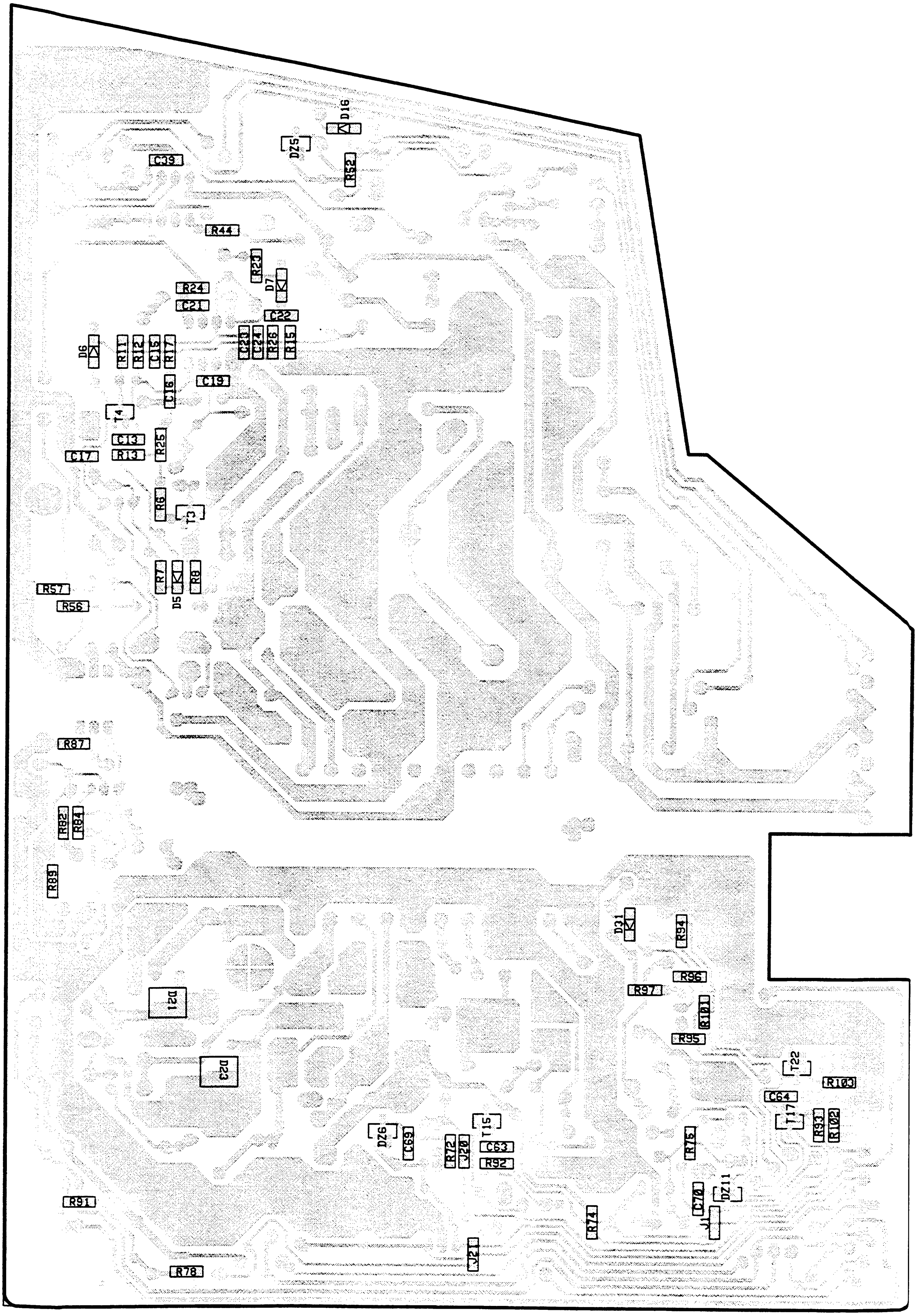
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D7
R24
C21
C22
C23
C24
R26
R15
D6
R11
R12
C15
R17
C16
C19
T4
C13
R25
C17
R13
R6
T3
R7
D5
R8
R57
R56
R87
R82
R84
R89
D31
R94
R96
R97
D21
R101
R95
T22
D23
R103
C64
T17
R93
R102
T15
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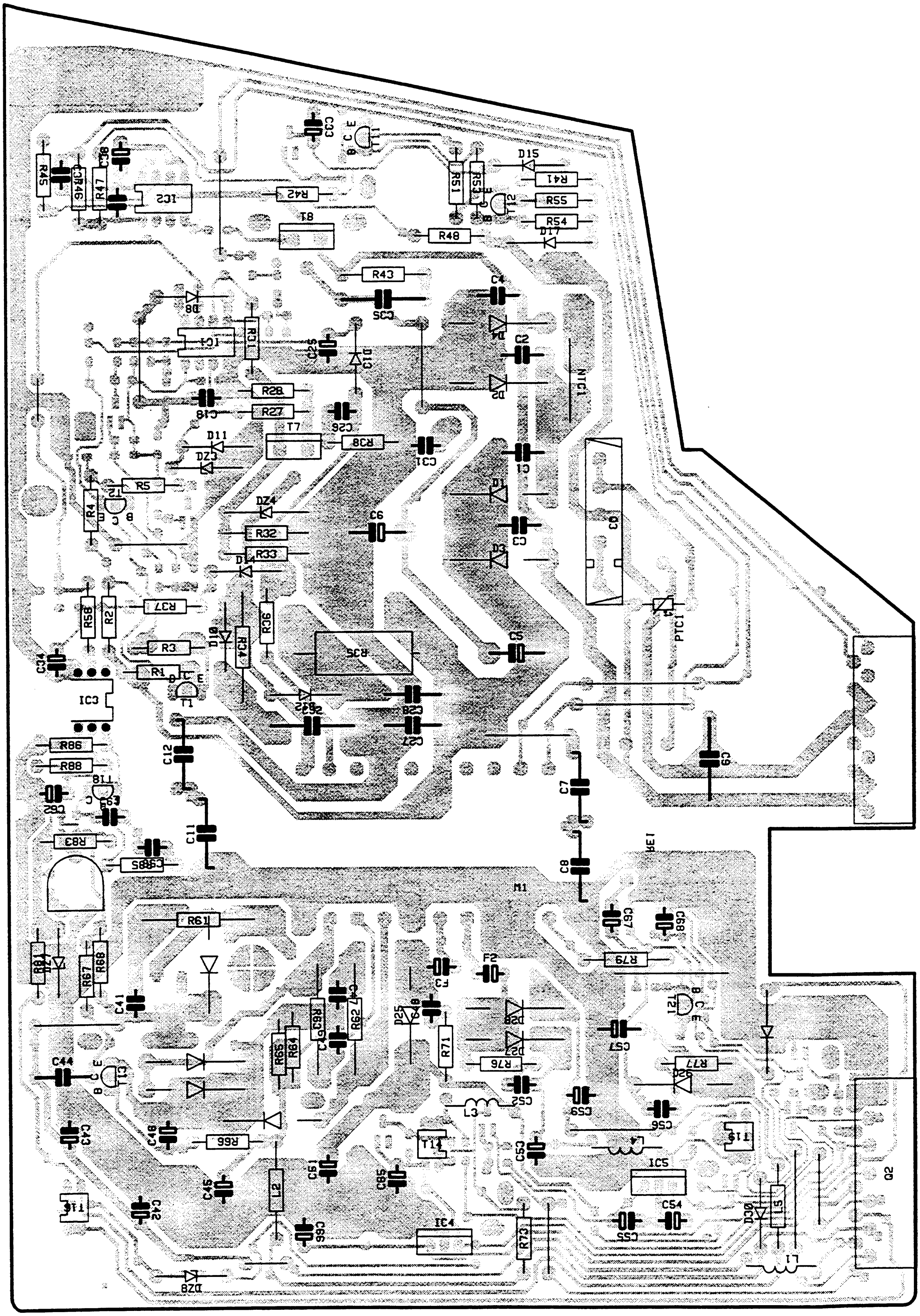
J20
C63
R92
R75
DZ11
C70
J1
R91
R74
J21
R78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R47
C38
IC2
R42
R51
R53
T12
D15
R41
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R54
D17
T8
R48
R43
C4
D8
R31
IC1
C35
C25
D13
D4
C2
R28
C18
R27
C26
D2
IC1
T7
R38
C31
C1
D11
DZ3
R5
T2
R4
D1
DZ4
C6
R32
C3
D3
R33
D14
C9
R58
R2
R37
R36
D10
R34
PTC1
R3
R35
C5
C34
R1
T1
IC3
D12
C28
C29
C27
R86
R88
C12
T18
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R83
C85
C8
RE1
M1
R61
C67
C68
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R60
R79
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R63
R62
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D25
C48
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D27
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R65
R64
R71
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T13
R76
R77
D26
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C46
R66
T14
T15
C53
IC5
C61
C65
C45
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C66
IC4
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D30
L5
L1
Q2
DZ8

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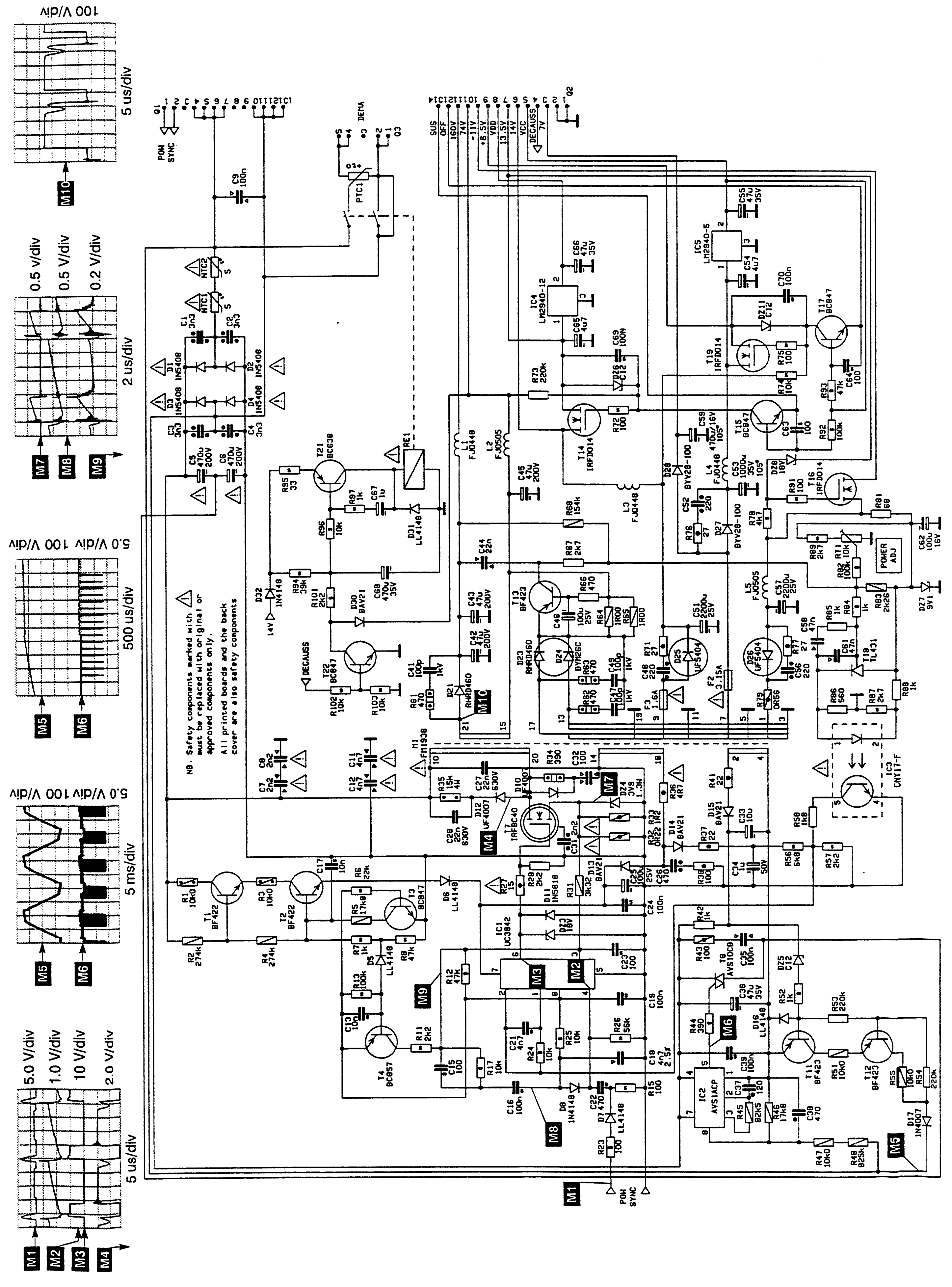
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5 us/div
M10
0.5 V/div
0.5 V/div
0.2 V/div
2 us/div
M7
M8
M9
5.0 V/div
100 V/div
500 us/div
M5
M6
5.0 V/div
100 V/div
5 ms/div
M5
M6
5.0 V/div
1.0 V/div
10 V/div
2.0 V/div
5 us/div
M1
M2
M3
M4
POW SYNC
Q1
Q2
Q3
DEMA
PTC1
C9 100n
NTC1
NTC2
C1 3n3
C2 3n3
D1 1N5408
D2 1N5408
D3 1N5408
D4 1N5408
C3 3n3
C4 3n3
C5 470u 200V
C6 470u 200V
RE1
T21 BC638
R95 33
R97 1k
C67 1u
D31 LL4148
R96 10k
R94 39k
D32 1N4148
14V
R101 2k2
D30 BAV21
C68 470u 35V
DEGAUSS
T22 BC847
R102 10k
R103 10k
L1 FJ0448
L2 FJ0505
C45 47u 200V
C44 22n
C43 47u 200V
C42 47u 200V
C41 100p 1kV
R61 470
D21 RHRD460
M1
T13 BF423
R68 154k
R67 2k7
R66 470
R64 1R00
R65 1R00
C46 100u 25V
D23 RHRD460
D24 BYW26C
R62 470
R63 470
C47 100p 1kV
C49 100p 1kV
C48 220
F3 1.6A
F2 3.15A
R71 27
D25 UF5404
C51 2200u 25V
SUS
OFF
160V
74V
-11V
+8.5V
VDD
13.5V
14V
VCC
DEGAUSS
7V
IC4 LM2940-12
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C65 4u7
C69 100N
R73 220k
DZ6 C12
T14 IRFD014
R72 100
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D28 BYV28-100
C59 470u 16V 105°
L4 FJ0448
C53 1000u 35V 105°
C52 220
R76 27
D27 BYV28-100
IC5 LM2940-5
C55 47u 35V
C54 4u7
C70 100n
DZ11 C12
T19 IRFD014
R75 100
T17 BC847
R74 10k
R93 47k
C64 100
T15 BC847
C63 100
R92 100k
DZ8 18V
R91 100
T16 IRFD014
R81 68
R78 4k7
C62 100u 16V
R89 2k7
R71 10k
POWER ADJ
R82 100k
L5 FJ0505
C57 2200u 25V
R83 2k26
DZ7 9V1
R85 1k
R84 1k
C58 47n
C61 47n
R77 27
D26 UF5404
C56 220
T18 TL431
R88 1k
R79 0R56
R86 560
R87 2k7
IC3 CNY17-F
NB. Safety components marked with △ must be replaced with original or approved components only.
All printed boards and the back cover are also safety components
C7 2n2
C8 2n2
C12 4n7
C11 4n7
M1 FM1938
R35 15k 4W
C27 22n 630V
D10 UF4007
R34 390
C32 100
C28 22n 630V
D12 UF4007
T7 IRFBC40
M4
M7
DZ4 3V9 1.3W
R36 4R7
C31 2n2
R32 0R22
R33 1R2
R41 22
D15 BAV21
D14 BAV21
C33 10u
R37 22
C34 1u 50V
R58 1k8
R56 6k8
R57 2k2
R1 10k0
T1 BF422
R3 10k0
T2 BF422
C17 10n
R6 22k
R5 17k8
T3 BC847
R2 274k
R4 274k
R7 1k
D5 LL4148
R8 47k
D6 LL4148
R27 15
R28 2k2
D11 1N5818
R31 3k32
D13 BAV21
DZ3 18V
C25 1000u 25V
C26 470
R38 100
C24 100n
IC1 UC3842
M3
M2
C23 100
R12 47k
M9
R13 100k
C13 10n
T4 BC857
R11 2k2
C15 100
R17 10k
C21 4n7
R24 10k
R25 10k
R26 56k
C19 100n
C18 4n7 2.5%
C16 100n
M8
D8 1N4148
C22 470
D7 LL4148
R23 100
R15 100
R42 1k
R43 100
T8 AVS10CB
C35 100n
C36 47u 35V
R44 390
M6
DZ5 C12
R52 1k
D16 LL4148
R53 220k
C39 100n
IC2 AVS1ACP
C37 120
R45 82k5
R46 17k8
C38 470
T11 BF423
R51 10k0
T12 BF423
R55 10k0
R54 220k
D17 1N4007
R47 10k0
R48 825k
M5
M1
POW SYNC

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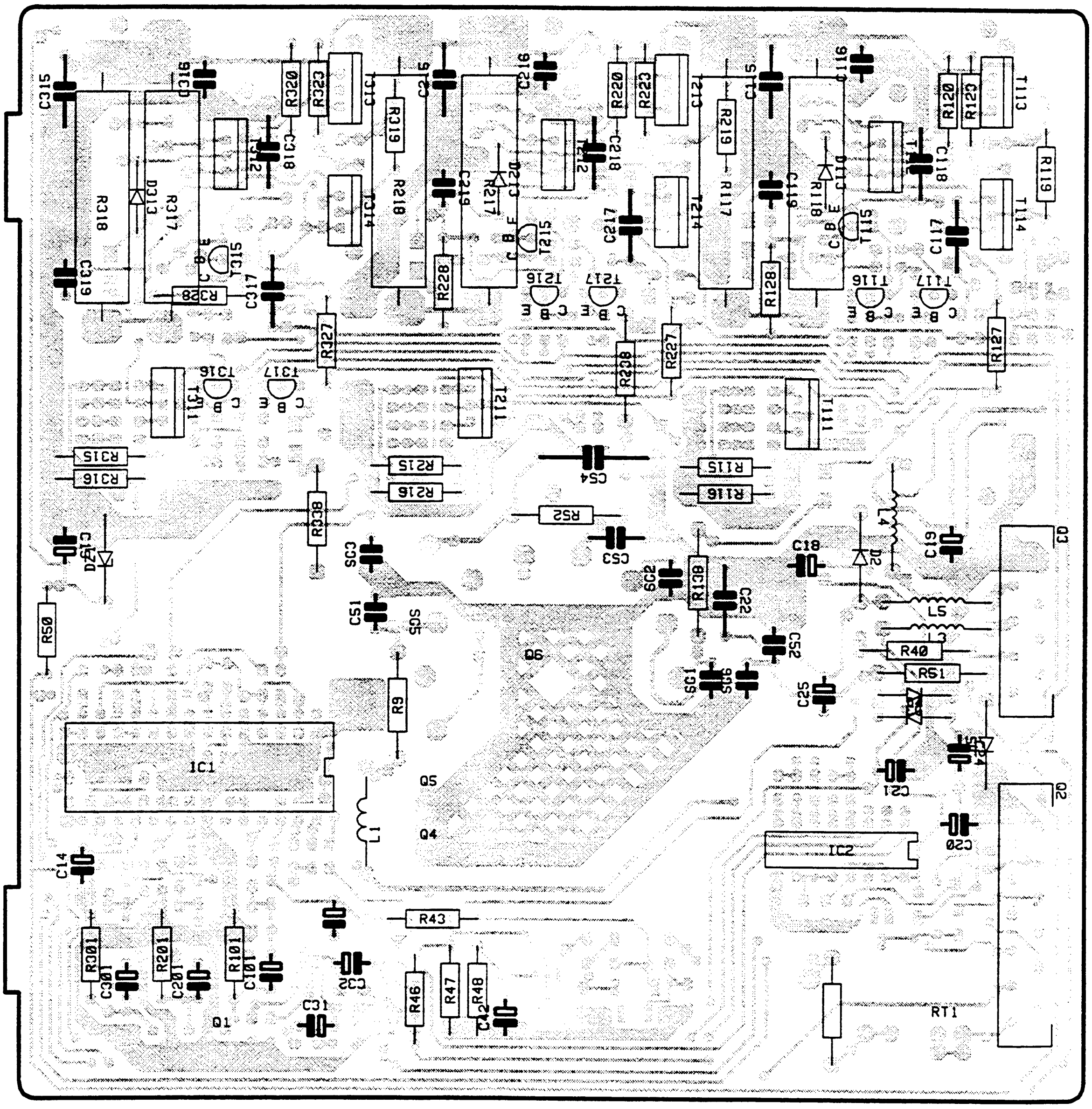
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T213
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C115
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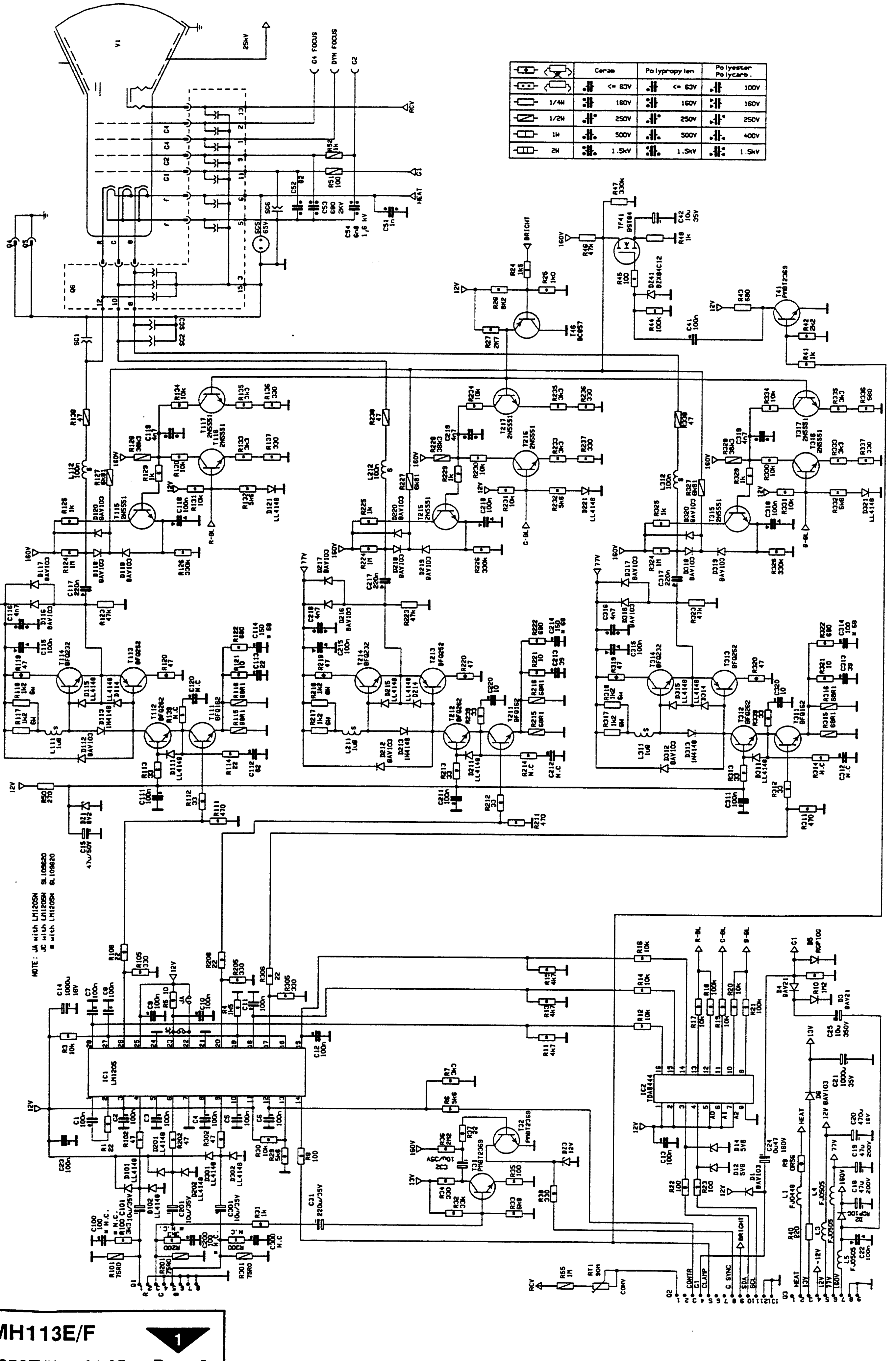
T113
R319
C318
T312
C218
T212
R219
C118
T112
R119
R318
D313
R317
R318
C319
T314
C219
D212
R217
C120
T214
R117
C119
D112
R118
C110
T114
C117
C217
T315
T215
T115
C319
C317
R328
R228
R128
T216
T217
T116
T117
R327
R227
R238
R127
T316
T317
T311
T211
T111
R315
R316
R215
R216
CS4
R115
R116
R338
R52
L4
Q3
C12
D2
SC3
CS3
C18
D2
C19
R50
SC2
R139
C22
C51
SG5
L5
CS2
Q6
R40
SC1
SG6
R51
C25
R9
IC1
Q5
C21
Q2
L1
Q4
IC2
C20
C14
R43
R301
R201
R101
C301
C201
C101
C3
C31
R46
R47
R48
C42
RT1
Q1

447E



Ceram
Polypropylen
Polyester Polycarb.
1/4W
1/2W
1W
2W
<= 63V
100V
160V
250V
500V
400V
1.5kV
V1
25kV
G4 FOCUS
DYN FOCUS
G2
RCV
G1
HEAT
IC1 LM1205
IC2 TDA8444
R-BL
G-BL
B-BL
BRIGHT
12V
160V
77V
NOTE: JA with LM1205N SL109620
JC with LM1205N SL109620
■ with LM1205N SL109620
CONTR
CLAMP
C SYNC
SDA
SCL
CONV
Q1
Q2
Q3

SMH113E/F

1

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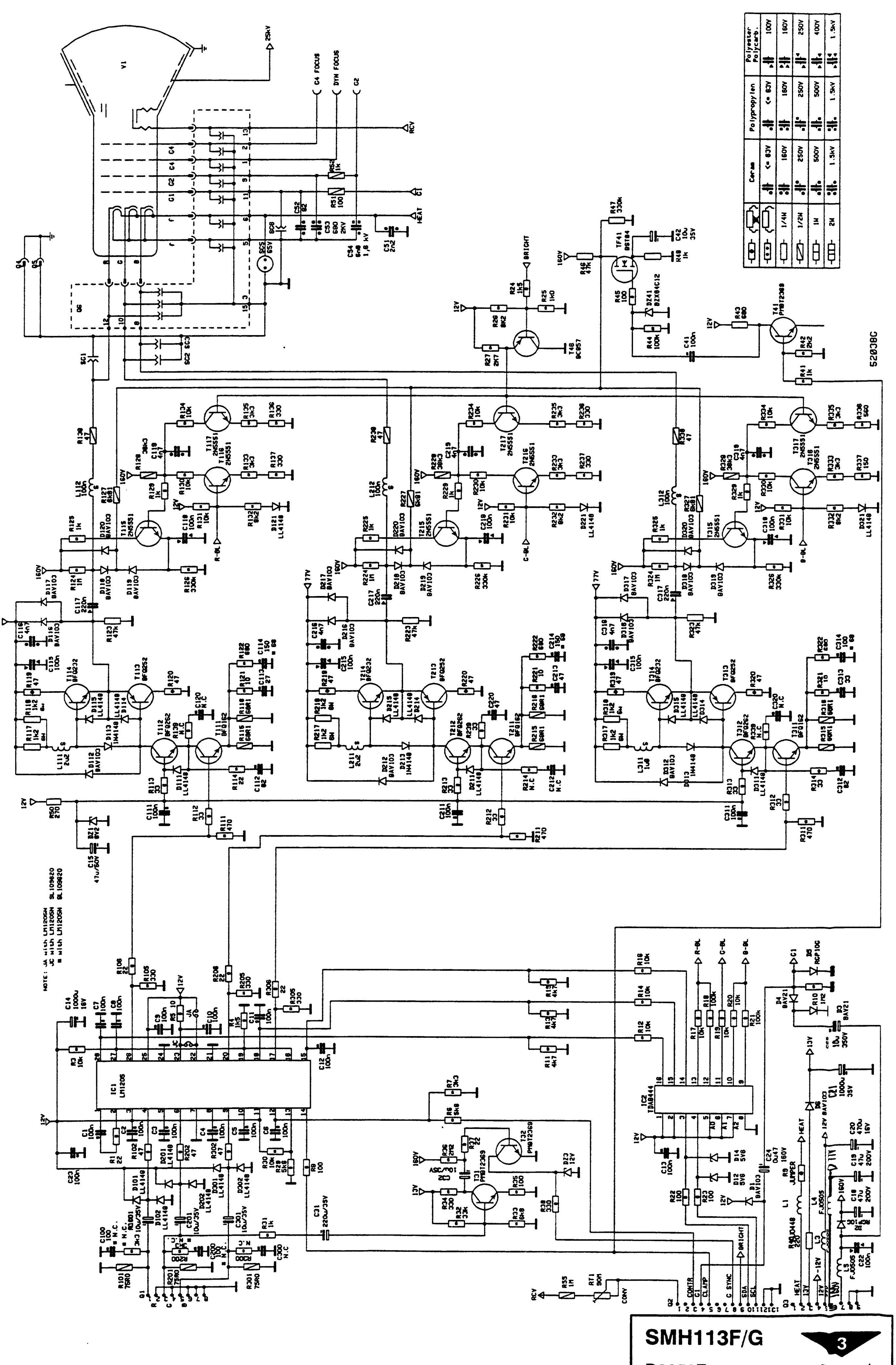
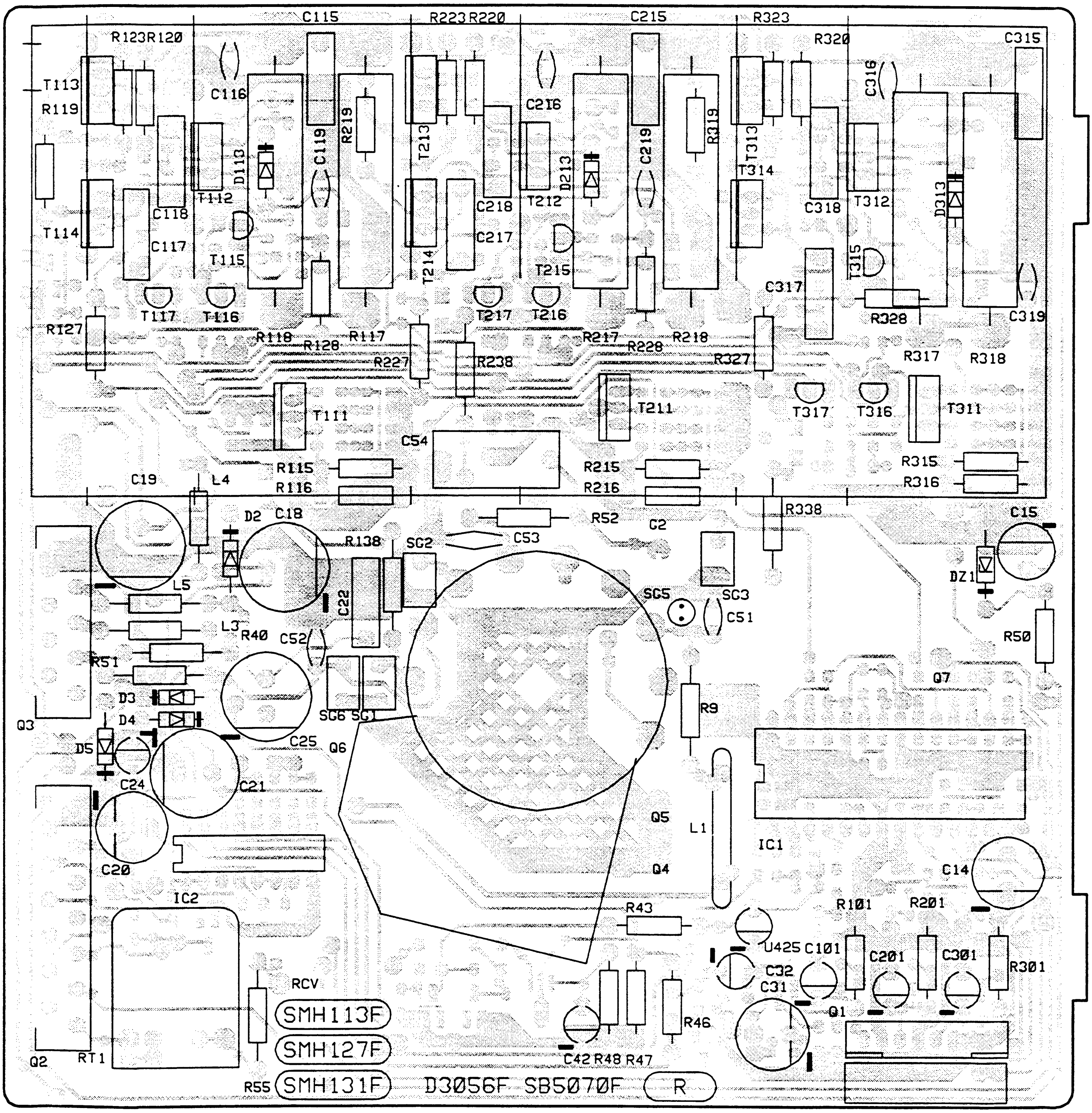
447E

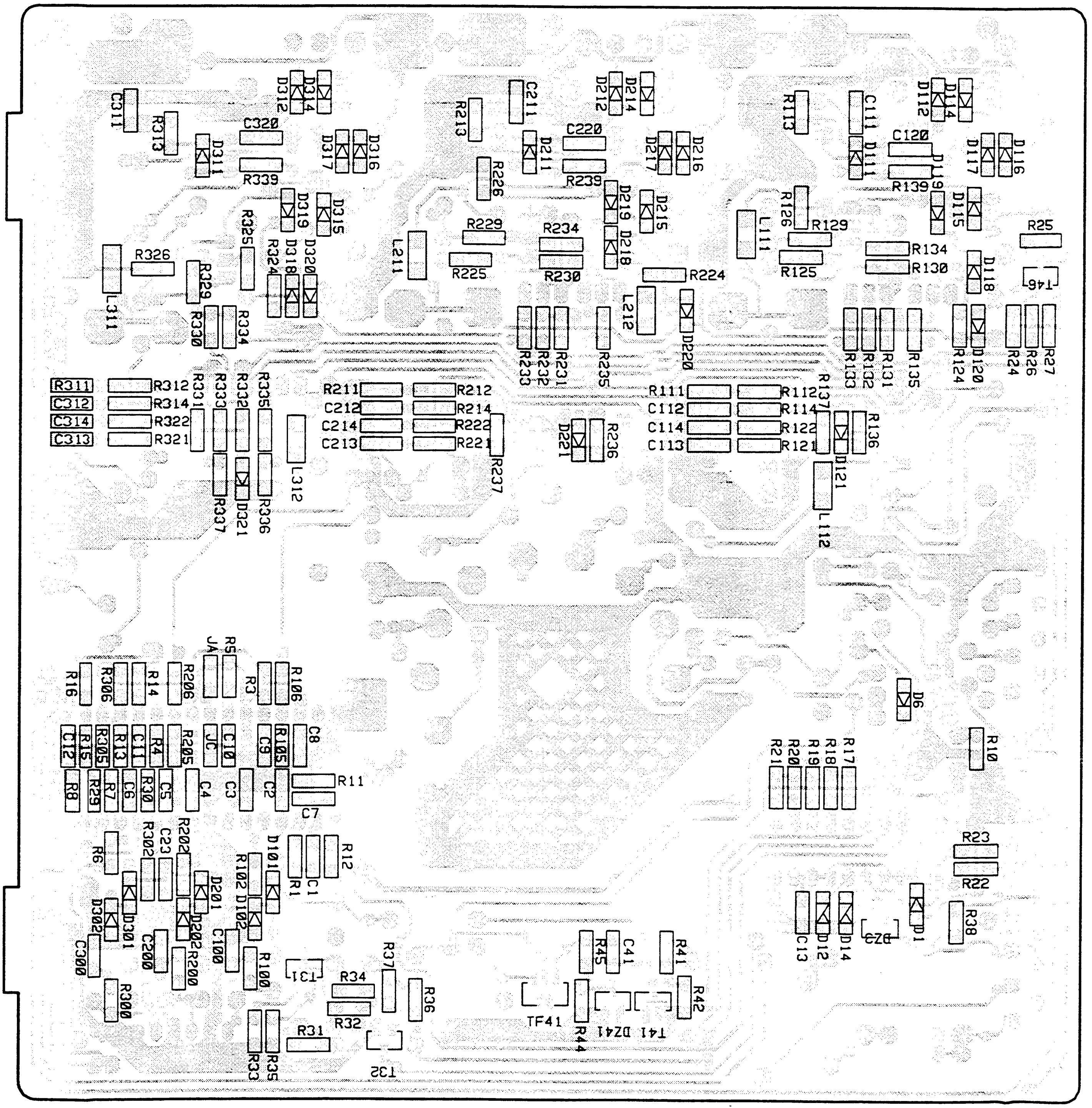

V1
25kV
G4 FOCUS
DYN FOCUS
G2
RGV
G1
HEAT
BRIGHT
IC1 LM1205
IC2 TDA9444
R-BL
G-BL
B-BL
CONTR
CLAMP
C SYNC
SDA
SCL
CONV
160V
77V
12V
52038C
NOTE : JA with LM1205N SL109820
JC with LM1205N SL109820
■ with LM1205N SL109820
Ceram
Polypropylen
Polyester Polycarb.

SMH113F/G

3

D3056F 05.96 Page 1


C115
R223 R220
C215
R323
R123 R120
R320
C315
T113
R119
C116
C216
C316
R219
D113
C119
T213
D213
C219
R319
T313
T314
T112
C118
C218
T212
T312
D313
C318
T114
C117
C217
T214
T215
T315
T115
C317
C319
T117
T116
T217
T216
R328
R127
R118
R128
R117
R217
R228
R218
R227
R238
R327
R317
R318
T111
T211
T317
T316
T311
C54
R115
R215
R315
R116
R216
R316
C19
L4
D2
C18
R52
C2
R338
C15
R138
SG2
C53
DZ1
L5
C22
SG5
SG3
C51
L3
R40
C52
R50
R51
Q7
D3
R9
D4
SG6
SG1
Q3
D5
C25
Q6
C24
C21
Q5
L1
IC1
C20
Q4
C14
IC2
R43
R101
R201
U425
C101
C201
C301
R301
C32
C31
RCV
Q1
SMH113F
R46
SMH127F
C42 R48 R47
Q2
RT1
R55
SMH131F
D3056F SB5070F
R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R313
D312
D314
C320
D311
D317
D316
R339
D319
D315
R325
R324
D318
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R329
L311
R330
R334
R311
R312
C312
R314
C314
R322
C313
R321
R331
R333
R332
R335
L312
R337
D321
R336
R213
C211
D212
D214
C220
D211
D217
D216
R226
R239
D219
D215
D218
R229
R234
L211
R225
R230
R224
L212
D220
R233
R232
R231
R235
R211
R212
C212
R214
C214
R222
C213
R221
R237
D221
R236
R113
C111
D112
D114
C120
D111
D119
D117
D116
R139
R126
R129
L111
D115
R25
R134
R125
R130
D118
T46
R133
R132
R131
R135
R124
D120
R24
R26
R27
R137
R111
R112
C112
R114
C114
R122
C113
R121
R136
D121
L112
R5
JA
R16
R306
R14
R206
R3
R106
C12
R15
R305
R13
C11
R4
R205
JC
C10
C9
R105
C8
R8
R29
R7
C6
R30
C5
C4
C3
C2
R11
C7
D6
R10
R21
R20
R19
R18
R17
R6
R302
C23
R202
D101
R12
R102
D102
R1
C1
D201
D302
D301
D202
C200
C100
R200
R100
C300
R300
T31
R34
R37
R36
R32
R31
R33
R35
T32
R45
C41
R41
R42
TF41
R44
DZ41
T41
R23
R22
C13
D12
D14
CZ0
D1
R38

Part Number	Description	PG	Item Number						
JF0032	DI UF4007 1000V 1A 75N DO41/SOD57	4	D	012	010				
JF0033	DI UF5404 400V 3A 50NS	4	D	025	026				
JF0067	DI 1N4007 1000V 1A	1	D	017					
JF0072	DI BAV21 200V 250MA 50N	1	D	013	014	015			
JF0072	DI BAV21 200V 250MA 50N	1	D	030					
JF0096	DI BYV28–100 100V 3.5A 30N	7	D	027	028				
JF0166R	DIODE BYM26C 600V 2.3A SOD–64	6	D	024					
JF0206	SCHOTTKY RECTIFIER 30V 1A 1N5818	4	D	011					
JF4005	DI LL4148 75V 150MA 4N	1	D	005	006	007	016	031	
JF4101	DI RHRD460S 600V 4A 30NS TO–252	8	D	021	023				
JH0064	ZDI BZX83C9V1 9.1V 0.5W 5%	3	DZ	007					
JH0081	ZDI ZPY 3.9 3.9V 1.3W 5%	1	DZ	004					
JH0153	ZDI BZX83C18 0.5W 5% !	1	DZ	003	008				
JH4118	ZDI BZX84C12 12V 0.35W 5%	2	DZ	005	006	011			
JL0043	LED LTL3233–022	3	LED	003					SMM050
JL0056	LED DUALCOLOR RED/GREEN	6	LED	003					SMM051
JL0062	OPTOCOUPLER CNY17F–2 5,3KV	8	IC	003					
JM0205	TR BF423 P 250V 25MA	3	T	011	012	013			
JM0244	TR BF422 N 250V 25MA	2	T	001	002				
JM0239	TR BC638 P 60V 1A	4	R	021					
JM4105	TR BC847B N 45V 0.1A SOT23	2	T	003	015	017	022		
JM4114	TR BC857B P 45V 100MA	2	T	004					
JS0026	FET IRFBC40 N 600V 6.0A TO220 AB	10	T	007					
JS0033	FET IRFD014 N 60V 1.7A HD–1	7	T	014	016	019			
JX0010	TRIAC AVS10CB 600V 8A TO220	10	T	008					
JZ0005	SILICONE INSUL. PAD 19*13*0.22MM	1	T	007					
LM0602	IC LM2940CT–12 +12V REGULATOR	12	IC	004					
LM0603	IC LM2940CT LOW DROP REG.5V TO220	8	IC	005					
LM0663	IC TL431 VOLTAGE REFERENCE TO–92	6	T	018					
LM0763	IC UC3842 CURRENT MODE PWM CONT.	12	IC	001					
LM0815	IC AVS1ACP08 VOLT SWITCH CONTR.	14	IC	002					
QG0359	PUSH–BUTTON SWITCH 250V 6A W/PINS	16	Q	006					
QH0065	RELAY PCB–MOUNTING 12V 5A/250V	12	RE	001					
QK1080	MODULE CONNECTOR 1X13	6	Q	001					
QK1485	MODULE CONNECTOR 1X14	8	Q	002					
QK1285	ROW CONN 1X05	3	Q	003					
QK1587	COOLING & SUPP.PART FOR RESISTOR	1	RY	034	035	061	062	063	
QK1587	COOLING & SUPP.PART FOR RESISTOR	1	NTC	001					SMM050
QK1587	COOLING & SUPP.PART FOR RESISTOR	1	NTC	001	002				SMM051
QK1680	SOLDER SUPPORT 4–PIN	2	Q	009					
QT0733	FUSE R=5,0MM T 3,15A 250V IEC127	4	F	002					
QT0736	FUSE R=5,0MM T 1,6A 250V IEC127	4	F	003					
SE2534	MAINS SWITCH WIRE BUNDLE	9	Q	006					
SE2543	FLAT CABLE LED 4–PIN	8	Q	009					
UC0859	FASTENING SPRING	2	IC	005					
UC0859	FASTENING SPRING	2	T	008					
UC1140	HEATSINK	2	D	026					
UC1140	HEATSINK	2	IC	005					
UC1371	HEATSINK	3	T	008					
UC6639	HEATWSINK	16	T	007					
UC6551	FASTENING SPRING	3	T	007					
UC6768	HEATSINK	5	IC	004					
UC6784	HEATSINK	4	DM	021	023				
UC6784	HEATSINK	4	D	025					
UC6791	FASTENING SPRING	3	IC	004					

Part Number	Description	PG	Item Number		
AA0645	CF RES 0W25 68R J	1	R	081	
AA0665	CF RES 0W25 470R J	1	R	066	
AA0667	CF RES 0W25 560R J	1	R	086	
AA0673	CF RES 0W25 1K0 J	1	R	042 085 088	
AA0679	CF RES 0W25 1K8 J	1	R	058	
AA0681	CF RES 0W25 2K2 J	1	R	028	
AA0683	CF RES 0W25 2K7 J	1	R	067	
AA0729	CF RES 0W25 220K J	1	R	053 054 073	
AB0617	NF RES 0W25 4R7 J CF	1	R	036	
AB0629	NF RES 0W25 15R J CF	1	R	027	
AB0633	NF RES 0W25 22R J CF	1	R	037 041	
AB0635	NF RES 0W25 27R	1	R	071 076 077	
AB0649	NF RES 0W25 100R J CF	1	R	038	
AB0785	NF RES 0W5 0R22 J CF	2	R	032	
AB0795	NF RES 0W5 0R56 J CF	2	R	079	
AB0803	NF RES 0W5 1R2 J CF	1	R	033	
AB0849	NF RES 0W5 100R J CF	1	R	043	
AC8637	CHIPRES 0W12 33R J	1	R	095	
AC8649	CHIPRES 0W12 100R J	1	R	015 072 075 091 023	
AC8661	CHIPRES 0W12 330R J	1	R	110 111 112	
AC8663	CHIPRES 0W12 390R J	1	R	044	
AC8673	CHIPRES 0W12 1K0 J	1	R	052 084 007 097	
AC8681	CHIPRES 0W12 2K2 J	1	R	011 101 057	
AC8683	CHIPRES 0W12 2K7 J	1	R	087 089	
AC8689	CHIPRES 0W12 4K7 J	1	R	078	
AC8693	CHIPRES 0W12 6K8 J	1	R	056	
AC8697	CHIPRES 0W12 10K J	1	R	025 102 024 074 096 103 017	
AC8705	CHIPRES 0W12 22K J	1	R	006	
AC8711	CHIPRES 0W12 39K J	1	R	094	
AC8713	CHIPRES 0W12 47K J	1	R	093 008 012	
AC8715	CHIPRES 0W12 56K J	1	R	026	
AC8721	CHIPRES 0W12 100K J	1	R	013 082 092	
AC8799	CHIPRES 0W12 0R0 JUMPER	1	J	001 020 021	
AG3101	MF RES 0W5 1R00 F	1	R	064 065	
AG3435	MF RES 0W5 2K26 F	1	R	083	
AG3451	MF RES 0W5 3K32 F	1	R	031	
AG3501	MF RES 0W5 10K0 F	1			
AG3501	MF RES 0W5 10K0 F	1	R	047 051 055	
AG3501	MF RES 0W5 10K0 F	1	RY	001 003	
AG3525	MF RES 0W5 17K8 F	1	R	005 046	
AG3589	MF RES 0W5 82K5 F	1	R	045	
AG3619	MF RES 0W5 154K F	1	R	068	
AG3643	MF RES 0W5 274K F	1	R	002 004	
AG3689	MF RES 0W5 825K F	1	R	048	
AJ2903	MO RES 2W0 390R J	1	RY	034	
AJ2923	MO RES 2W0 470R J	2	RY	062 063 061	
AJ3285	MO RES 4W0 15K J	3	RY	035	
AQ2347	TPMET. H10 10K	4	RT	001	
AW0089	DUAL–PTC 15 OHM/25'	17	PTC	001	
AW0111	NTC–THERMISTOR 5R0/25'C	7	NTC	001 002	SMM051
AW0111	NTC–THERMISTOR 5R0/25'C	7	NTC	002	SMM050
CA0324	CERCAP 100P K 1KV	2	C	041 047 049	
CB0732	CERCAP 120P J 50V	1	C	037	
CB4151	CHIPCAP 100P J 50V	2	C	023 063 064 015	
CB4167	CHIPCAP 470P J 50V	2	C	022	
CC0130	CERCAP 220P K 500V	1	C	048 052 056	
CC0170	CERCAP 470P K 500V	1	C	026	
CC0174	CERCAP 470P K 50V	1	C	038	
CC0244	CERCAP 2N2 K 50V	1	C	031	
CC0513	CERCAP 3N3 S 1KV	2	C	001 002 003 004	
CC4280	CHIPCAP 4N7 K 50V	2	C	021	
CC4320	CHIPCAP 10N K 50V	2	C	013 017	
CC4855	CHIPCAP 100N Z 50V	3	C	016 019 024 039 069 070	
CE0116	Y–CAP 2N2 M 400VAC	4	C	007 008	
CE0126	Y–CAP 4N7 M 400VAC	4	C	011 012	
CE0210	X2–CAP 100N M 250VAC	5	C	009	
CE2004	IMPCAP 100P K 1K6V	3	C	032	
CG2663	PPRCAP 4N7 H 63V	4	C	018	
CK0165	PESCAP 22N K 630V	2	C	027 028 044	
CK0287	PESCAP 100N K 400V	3	C	035	
CK2545	PESCAP 47N K 63V	2	C	058 061	
CN0082	ELCAP 470U M 200V	14	C	005 006	
CN0606	ELCAP 470U M 35V	5	C	068	
CN2017	ELCAP 1U0 M 50V	2	C	034 067	
CN2566	ELCAP 4U7F M 50V	2	C	054 065	
CN2032	ELCAP 10U M 50V	1	C	033	
CN2435	ELCAP 47U M 35V	2	C	036 055 066	
CN0819	ELCAP 2200U M 25V	5	C	051 057	
CN2467	ELCAP 47U M 200V	5	C	045	
CN2467	ELCAP 47U M 200V	5	C	042 043	
CN2523	ELCAP 100U M 25V	3	C	025 046 062	
CN2642	ELCAP 470U M 16V	4	C	059	
CN2712	ELCAP 1000U M 16V	5	C	053	
FJ0448	CHOKE 15UH	2	L	001 004 003	
FJ0505	CHOKE 15UH 5%	2	L	002 005	
FM1938A	SMPS–TRAFO ETD49	20	M	001	
JB0046	DI 1N5408 1000V 3A DO–201AD	3	DY	001 002 003 004	
JF0025	DI 1N4148 75V 200MA 4N	1	D	008 032	
JF0025	DI 1N4148 75V 200MA 4N	1	J	011	

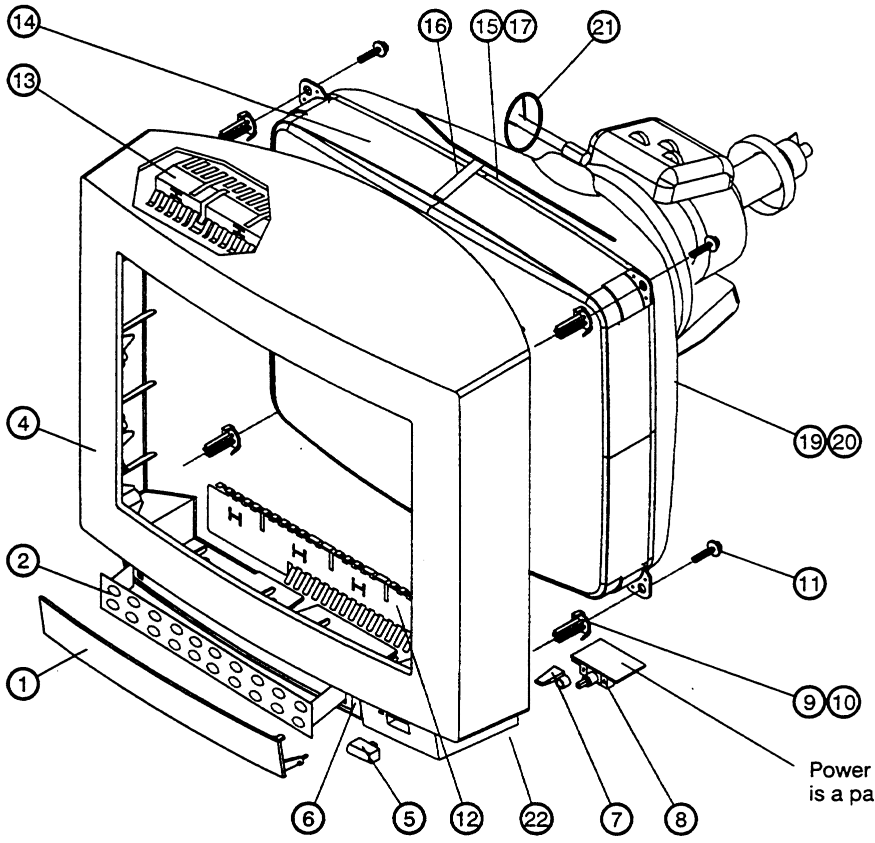
Part Number	Description	PG	Item Number
JM0306	TR BFQ162 N 10V 500MA 1GHZ TO–126	19	T 111 211 311
JM0307	TR BFQ262 N 65V 400MA 1GHZ TO–126	12	T 112 212 312
JM4114	TR BC857B P 45V 100MA 150M:	2	T 046
JM4116	TR PMBT2369 N 15V 200MA SOT–23	3	T 031 032 041
JM4305	TR BST84 N 200V 250MA 250MS SOT89	12	TF ... 041
JZ0017	SILICONE INSUL.10X13X0,22 TO–126	2	TH ... 113 114 213 214 313 314
LM0777	IC TDA8444 6–BIT OCT.DAC DIL–16	15	IC ... 002
LM0920	IC LM1205N VIDEO AMPL.3–CH 130MHZ	19	IC ... 001
QK0851	TAP CONN RTM 1,3/5/8.002	1	Q 004 005
QK1470	ROW CONN 1X08	5	Q 001
QK1587	COOLING & SUPP.PART FOR RESISTOR	1	R 117 118 217 218 317 318
QK1600	CRT SOCKET FOR 17 SONY	17	Q 006
QK1639	ROW CONN 1X09	3	Q 003
QK1643	ROW CONN 1X13	4	Q 002
QT0002	SPARK GAP 1,2KV +–500V R=5,0MM	3	SG .. 001 002 003 006
QT0217	GLIMM LAMP 65V 6*16MM	3	SG .. 005
SE2282	WIRE SMH	6	
UC2817	HEATSINK	14	TH ... 112 212 312
UC3424	FASTENING SPRING	2	TH ... 112 212 312
UC6647	HEATSINK	9	TH ... 113 114 213 214 313 314
UC6648	COVER FOR INTEFERENCE SHIELD	17	TH
UC6649	INTEFERENCE SHIELD	21	TH
UC6668	FASTENING SPRING	2	TH ... 113 114 213 214 313 314
UC6733	SHIELD FOR SOCKET BOARD	9	
UG0290	SUPPORT STUD	2	
UP0118	CERAMIC ISOLATOR	8	TH ... 112 212 312
WC0036	PT–SCREW	1	

Part Number	Description	PG	Item Number
AA0659	CF RES 0W25 270R J	1	R 050
AA0669	CF RES 0W25 680R J	1	R 043
AA0673	CF RES 0W25 1K0 J	1	R 048
AA0713	CF RES 0W25 47K J	1	R 046 123 223 323
AA0733	CF RES 0W25 330K J	1	R 047
AB0641	NF RES 0W25 47R J CF	1	R 119 120 219 220 319 320
AB0857	NF RES 0W5 220R J CF	1	R 040
AC8625	CHIPRES 0W12 10R J	1	R 005 121 221 321
AC8665	CHIPRES 0W12 470R J	1	R 111 211 311
AC8633	CHIPRES 0W12 22R J	1	R 001 037 106 206 306 114
AC8637	CHIPRES 0W12 33R J	1	R 112 212 312 113 213 313 339 239
AC8641	CHIPRES 0W12 47R J	1	R 102 202 302
AC8649	CHIPRES 0W12 100R J	1	R 008 022 023 035 045
AC8661	CHIPRES 0W12 330R J	1	R 034 105 237 205 305 337 137 236 136
AC8661	CHIPRES 0W12 330R J	1	RH 038
AC8667	CHIPRES 0W12 560R J	1	R 336
AC8669	CHIPRES 0W12 680R J	1	R 122 222 322
AC8673	CHIPRES 0W12 1K0 J	1	R 041 125 129 225 229 325 329 031 025
AC8677	CHIPRES 0W12 1K5 J	1	R 004 024
AC8681	CHIPRES 0W12 2K2 J	1	R 042
AC8683	CHIPRES 0W12 2K7 J	1	R 027
AC8685	CHIPRES 0W12 3K3 J	1	R 007 135 335 133 233 235 333
AC8689	CHIPRES 0W12 4K7 J	1	R 011 013 015
AC8691	CHIPRES 0W12 5K6 J	1	R 029 132 232 332 006
AC8693	CHIPRES 0W12 6K8 J	1	R 033
AC8695	CHIPRES 0W12 8K2 J	1	R 026
AC8697	CHIPRES 0W12 10K J	1	R 003 012 014 016 130 131 134 230 231 234
AC8697	CHIPRES 0W12 10K J	1	R 330 331 334 030 017 019 020
AC8709	CHIPRES 0W12 33K J	1	R 032
AC8721	CHIPRES 0W12 100K J	1	R 021 018 044
AC8733	CHIPRES 0W12 330K J	1	R 126 226 326
AC8745	CHIPRES 0W12 1M0 J	1	R 124 224 324
AC8747	CHIPRES 0W12 1M2 J	1	R 010
AC8753	CHIPRES 0W12 2M2 J	1	R 036
AC8799	CHIPRES 0W12 0R0	1	JC
AG1284	MF RES 0W16 75R0 1%	1	R 101 201 301
AG3281	MF RES 0W5 68R1 F	1	R 115 116 215 216 315 316
AG3481	MF RES 0W5 6K81 F	1	R 127 227 327
AG3557	MF RES 0W5 38K3 F	1	R 128 228 328
AD0341	COMPRES 0W5 47R K	3	R 138 238 338
AD0349	COMPRES 0W5 100R K	1	R 051
AD0373	COMPRES 0W5 1K0 K	1	R 052
AD0445	COMPRES 0W5 1M0 K	1	R 055
AJ3027	MO RES 6W0 1K2 J 9–33	2	R 117 118 217 218 317 318
AP1021	PMET 90M 4KV	12	RTH 001
CA0318	CERCAP 680P M 2KV	2	C 053
CB0658	CERCAP N750 82P J 500V	1	C 052
CB4135	CHIPCAP 27P J 50V	2	C 113
CB4137	CHIPCAP 33P J 50V	1	C 313
CB4141	CHIPCAP 47P J 50V	2	C 220 213 320
CB4145	CHIPCAP 68P J 50V	2	C 114 214 314
CB4147	CHIPCAP 82P J 50V	2	C 112
CC0240	CERCAP 2N2 K 500V	1	C 051
CC0530	CERCAP Z5U 4N7 S 500V	1	C 116 119 216 219 316 319
CC4855	CHIPCAP 100N Z 50V	3	C 001 002 003 004 005 006 007 008 009 010
CC4855	CHIPCAP 100N Z 50V	3	C 011 012 013 023 041 111 211 311
CE2325	IMPCAP 6N8 J 1K6V	5	C 054
CK0284	PESCAP 100N K 250V	2	C 118 218 318 022 115 215 315
CK0341	PESCAP 220N K 100V	3	C 117 217 317
CN0128	ELCAP 0U47 M 160V	3	C 024
CN2032	ELCAP 10U M 50V	1	C 042 032 101 201 301
CN2435	ELCAP 47U M 35V	2	C 015
CN2044	ELCAP 10U M 350V	7	C 025
CN2467	ELCAP' 47U M 200V	5	C 019 018
CN2581	ELCAP 220U M 35V	3	C 031
CN2642	ELCAP 470U M 16V	4	C 020
CN2711	ELCAP 1000U M 16V	3	C 014
CN2716	ELCAP 1000U M 35V	9	C 021
FA0010	CHIP COIL 100NH 10%	3	L 112 212 312
FA0023	CHIP COIL 1U8	4	L 311
FA0024	CHIP COIL 2U2 10%	3	L 111 211
FJ0505	CHOKE 15UH 5%	2	L 003 004 005
FJ0448	CHOKE 15UH	2	L 001
JF0025	DI 1N4148 75V 200MA	1	D 113 213 313
JF0072	DI BAV21 200V 250MA	1	D 003 004
JF0073	DI RGP10G 400V 1A	4	D 002 005
JF4003	DI BAV103 200V 250MA 50NS SOD–80	7	D 112 116 117 118 119 120 212 216 217 218
JF4003	DI BAV103 200V 250MA 50NS SOD–80	7	D 219 220 312 316 317 318 319 320 006 001
JF4005	DI LL4148 75V 150MA	1	D 101 102 111
JF4005	DI LL4148 75V 150MA	1	D 114 115 121 201 202 211 214 215 221
JF4005	DI LL4148 75V 150MA	1	D 301 302 311 314 315 321
JH0059	ZDI BZX83C8V2 8.2V 0.5W 5%	1	DZ 001
JH4118	ZDI BZX84C12 12V 0.35W 5%	2	DZ 041
JH4118	ZDI BZX84C12 12V 0.35W 5%	2	DZ 003
JH4218	ZDI BZV55C5V6 5V6 5% 500MW SOD80	2	DZ 012 014
JM0273	TR 2N5551 NPN 160V 0,6A	2	T 115 116 117 215 216 217 315 316 317
JM0301	TR BFQ232 N 65V 300MA 1GHZ TO–126	11	T 114 214 314
JM0302	TR BFQ252 P 65V 300MA 1GHZ TO126	11	T 113 213 313

Spare Parts

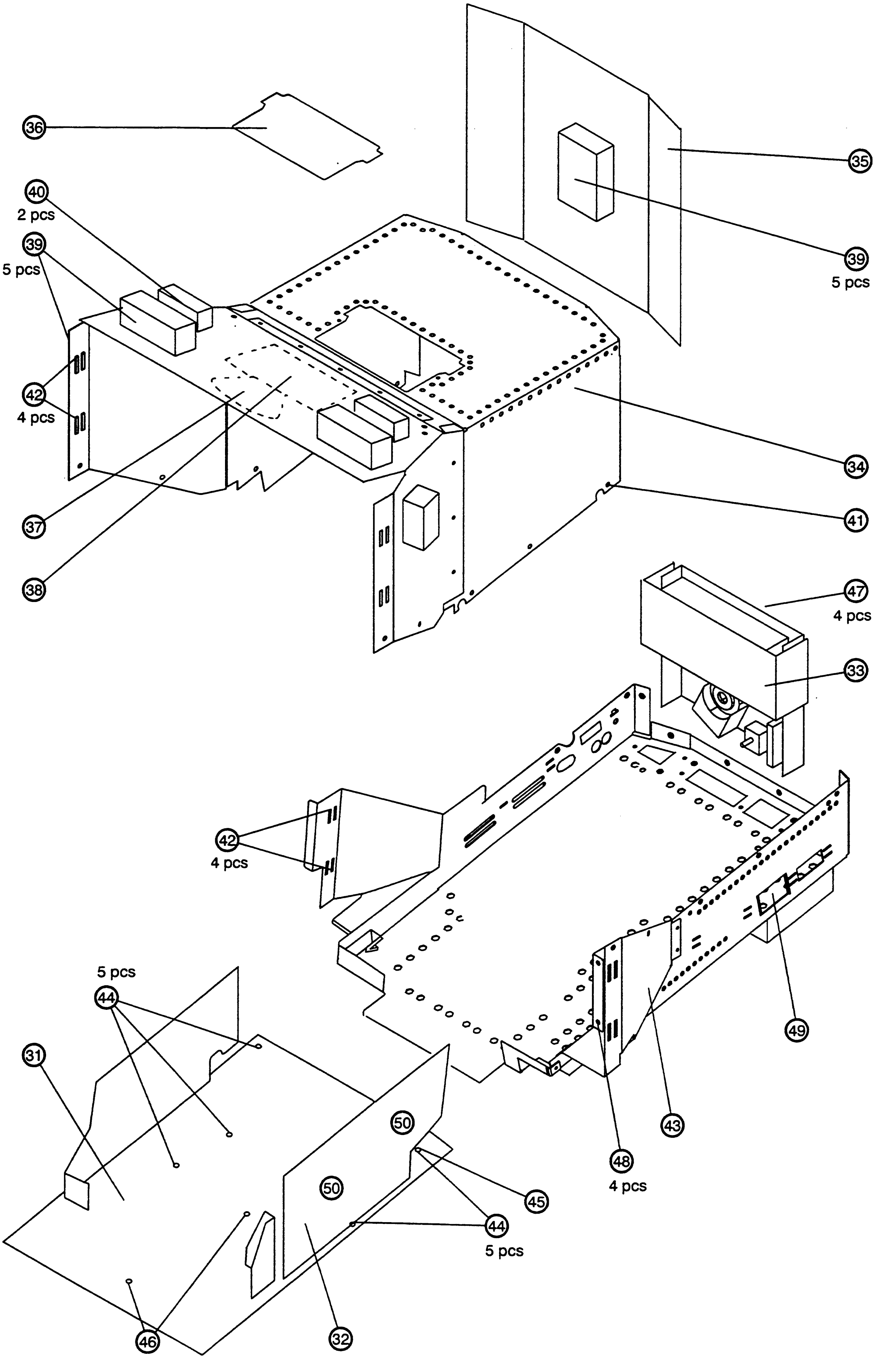
13.03.95

Production P/N	Name	Emission
447E058	17” Nokia Daisy USA	MPR

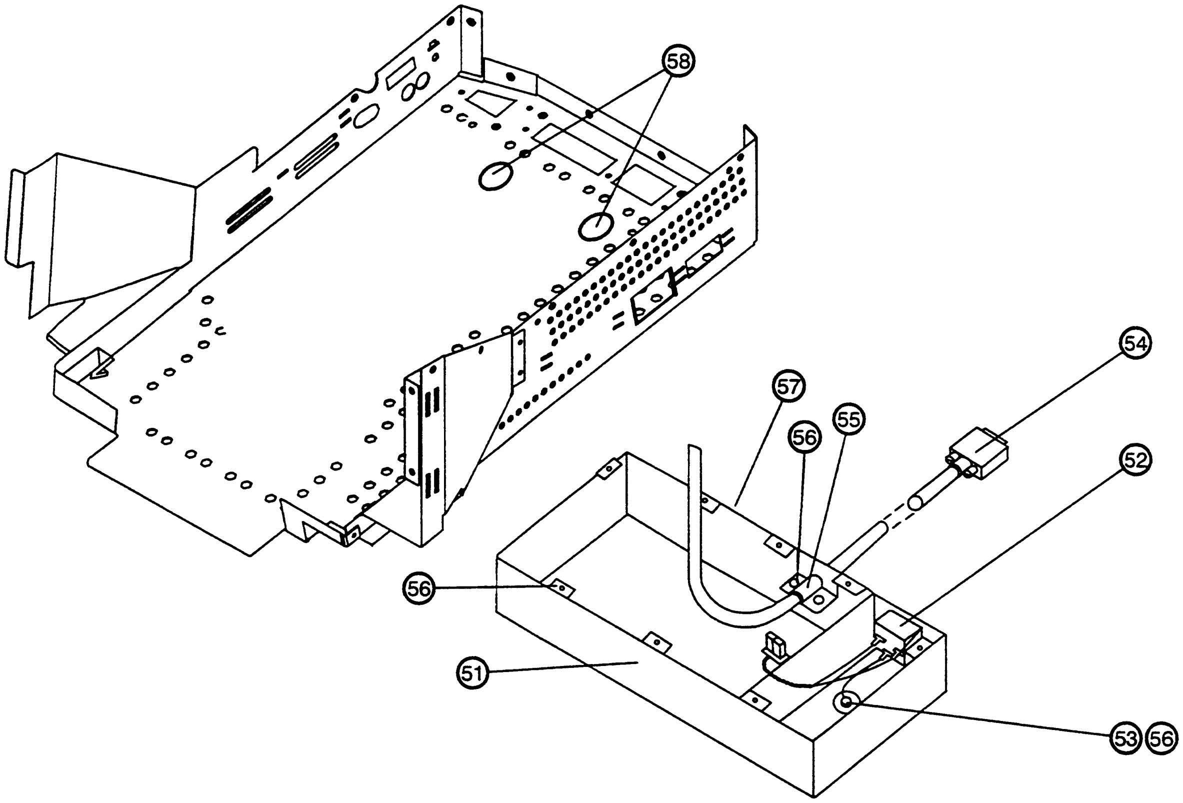


Power Switch submodule
is a part of SMM module

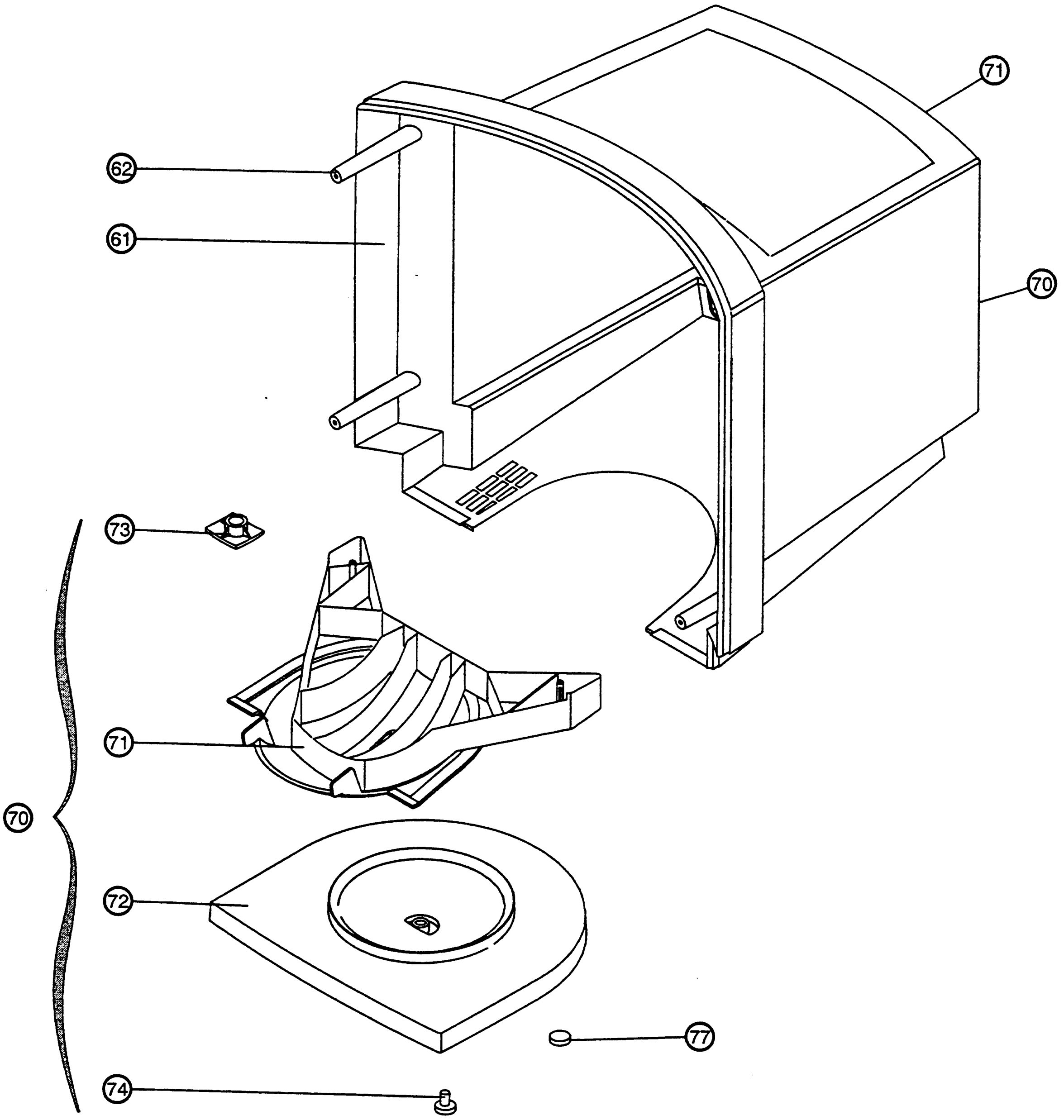
Item	Part number	Description	PG	447E
1	UA7250A	Door	13	
2	OQ0360	Membrane switch	23	
4	UM7120A	Bezel	25	
5	UT1812	Push button	5	
6	UZ0001	Lock	2	
7	UA7022	Lens	4	
8	WC0371	Pt-screw KB30X8	1	
9	UG0768	Slide	6	
10	UL0704	Foot	2	
11	WC0352	Pt-screw K 50X33	3	
12	UC6726	Grounding spring, lower	10	
13	UC6722	Grounding spring, upper	10	
14	NM0985	Picture tube 17SA2K-C5	99	
15	FD0171	Demagn. coil 17 double loop	19	
16	UG0758	Holder for degaussing coil	4	
17	UJ0221	Lead band PLT 4S 4,8X368 mm	3	
18	UG0753	Insulator	2	
19	SE2529	Grounding braid	8	
20	UC3016	Grounding spring for picture tube	4	
21	UJ0220	Cable clamp	5	
	UJ0125	Lead band SST 1 M	1	


㊱
㊵
2 pcs
㊴
5 pcs
㊷
4 pcs
㊲
㊳
㉟
㊴
5 pcs
㉞
㊶
㊼
4 pcs
㉝
㊷
4 pcs
㊾
5 pcs
㊹
㉛
㊿
㊿
㊺
㊹
5 pcs
㊸
㊽
4 pcs
㊻
㉜

Item	Part number	Description	PG	447E
31	SMA142	Monitor main board	60	
32	SMM051	Power supply	49	
33	SMH113	Socket board	50	
34	UC6723	Interf.jacked assy	22	
35	UC6710	IJ–Back plate	9	
36	UC6705	Cover 4	6	
38	UG0690	Insulator	12	
39	UA1279	Cushion support 60X60X40	5	
40	UA1221	Cushion support 60X60X20	4	
41	WC0036	Pt–screw	1	
42	UC6709	Grounding spring, side	5	
43	UC6725	Bottom body frame assy'	25	
44	WA0749	Screw M4X8	1	
45	WL0217	Sleeve 4,3 ST	1	
46	UG0778	Support stud	1	
47	UC6758	Snap in grounding	16	
48	WC0354	Pt–screw KB 40X20	1	
49	UC6745	Shield cover/main cable	4	
50	UC6732	Grounding sleeve	6	
	SE2557	Grounding wire frame–SMH	8	



Item	Part number	Description	PG	447E
51	UC6736	Connector box assy'	17	
52	SE2538	Mains connector wire bundle	18	
53	WL0217	Sleeve 4,3 ST	1	
54	QM0270	Signal cable VGA–26 scgrey	27	
	UJ0134	Lead band blue for signal cable	2	
55	UC6737	Strain relief	9	
56	WC0036	Pt–screw	1	
58	UL0706	Hole grommet HG–11	4	



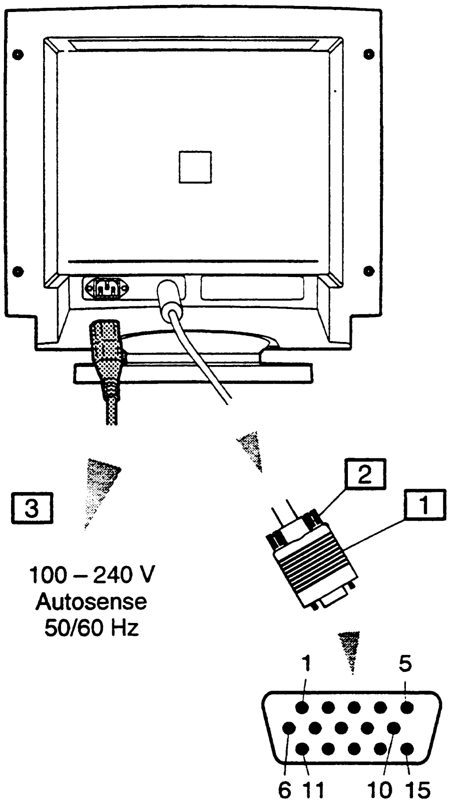
Item	Part number	Description	PG	447E
61	UD0600	Rear cover NCS1502–Y	29	
62	WC0354	Pt–screw KB 40X20	1	
70	UDX054	Stand assy Nokia PN201520	25	
71	US0021	Ball	17	
72	US0011	Stand	21	
73	UG0775	Puffer plate	4	
74	WA0736	Screw	6	
77	UL0099	Foot button SJ5012 White	2	
	UC3144	Spring	5	
	WL0163	Washer	2	
	ZZ2421	Warning label 27000 V	3	
	ZZ2438	Cover label 35x35 Energy Star	4	
	ZZ2471	Type label Nokia 447E MPR	4	

Item	Part number	Description	PG	447E
Packing materials				
	ZA1852	Lower support	99	
	ZA1853	Upper support	99	
	ZA2293	Packing box Nokia 447E USA	99	
Cables and documents				
	ZF5353	Users guide Nokia 447E USA	99	
	ZF5683	Warranty card Nokia USA Colorific	99	
	QM0049	Power cord 3*18AWG l=1,8m RAL 7032	24	

1.3. Monitor Connection

Make sure the power switches of the monitor and the computer and all attached devices are turned off before connecting the monitor.

1 Connect the signal cable to the computer.
2 Tighten the screws.
3 Connect the power cord first to the monitor and then to a grounded power outlet. Turn on the power switches for both the computer and the monitor. The picture will appear within about 20 seconds. Adjust the picture with the relevant adjust buttons to obtain optimum picture quality.



Pin configuration

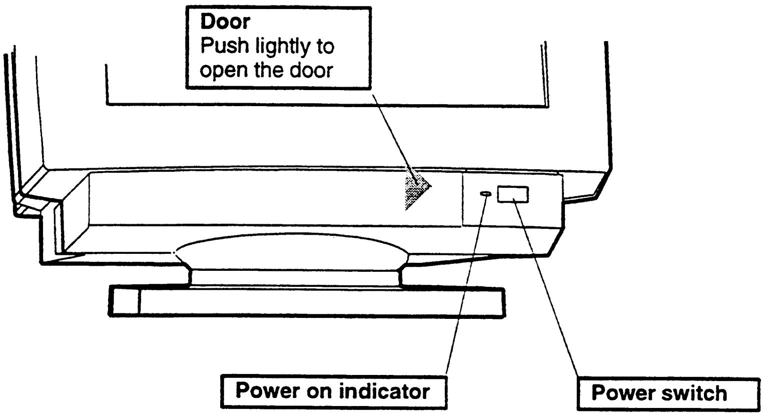
Pin		**Signa**	
1	<–	RV	Red
2	<–	GV	Green
3	<–	BV	Blue
4	–>	ID2	Monitor Identification (LG)
5		ST	Not used
6	<–	RG	Ground (red)
7	<–	GG	Ground (green)
8	<–	BG	Ground (blue)
9			Not used
10		LG	Ground (logic)
11	–>	ID0	Monitor Identification (LG)
12	–>	ID1	Monitor Identification (N.C.)
13	<–	HS	Horizontal sync.
14	<–	VS	Vertical sync.
15			Not used

<– Input
–> Output

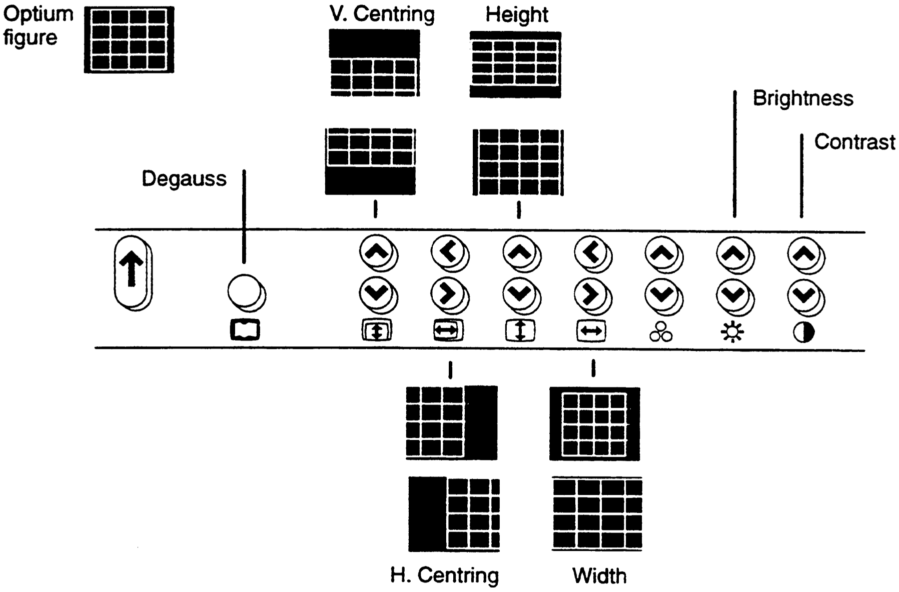
1.4. User Controls

The adjustments are made in normal User Mode and they are stored to the memory for user adjustments.

1.4.1. Front Panel


Door
Push lightly to open the door
Power on indicator
Power switch

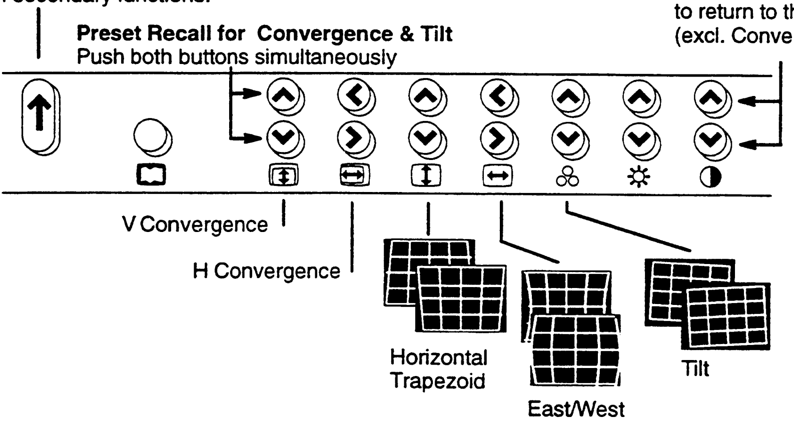
1.4.2. Primary Functions


Optium figure
V. Centring
Height
Brightness
Contrast
Degauss
H. Centring
Width

1.4.3 Secondary Functions

Shift button converts the controls to their secondary function which are labeled on the panel door.
First push the shift button and hold it down during adjustment of secondary functions.

Preset Recall:
Push both buttons simultaneously to return to the factory settings (excl. Convergence & Tilt)


Preset Recall for Convergence & Tilt
Push both buttons simultaneously
V Convergence
H Convergence
Horizontal Trapezoid
East/West
Tilt

2. Site Preparation

2.1. Location

This Monitor is designed for normal office conditions. It is equipped with own power supply. It is not to be serviced or repaired on site

2.2. Troubleshooting

Local service facilities should perform simple maintenance such as trimming. More advanced maintenance and repair that requires replacement of components which in turn requires testing and retrimming should be carried out in a central workshop.

Picture screen is blank	The indicator on the front panel is not illuminated	Check that the power cord is correctly connected to the monitor and to the power outlet. If the monitor is powered through the computer, check that the computer is switched on with the mains switch. Use a desk light, for example, to verify that current is connected to a power outlet. If no electricity is connected to the outlet, call an electrician.
		Switch off the monitor with the mains switch for about one minute.
	The indicator on the front panel is illuminated	The monitor might be in stand–by position. Push one of the buttons or move the mouse.
		Check that the keyboard's connection to the computer is OK.
		Adjust contrast and brightness to the maximum.
		Check that the signal cable connector is connected. If the connector is loose, tighten the connector's screws.
		Turn off the monitor with the power switch for about one minute.
		Switch off the monitor and the computer. Remove the signal cable from the computer. Switch on the monitor using the power switch. If a gray, slightly blinking frame (background) appears on the screen, it is evident that the monitor functions correctly and the problem is caused by an error in other parts of the system.
		Check the signal cable's connection pins. If the pins are slightly distorted, use nose pliers to straighten them.
		The computer may use a timing values which are out of the monitor's synchronization range.
Picture has colour defects		Demagnetize the monitor
		If colour defect is repeated without the monitor having been moved, it is possible that the monitor is influenced by a strong magnetic interference field (near to a high power cable, for example). Try to find a better location for the monitor or the interference source. Note that another monitor placed too near (less than 30 cm.) may also generate interference in the picture.
Picture is stable but distorted		Your computer may use a timing for which the corresponding picture characteristic adjustments have not been set at the factory. Adjust the picture characteristics
Picture is black and white		Check that the signal cable's connector is completely inserted. Switch off the computer and restart.

3. Controlling the Memory for Picture Adjustments

The picture adjustment values are stored in non-volatile memory. The memory has separated areas for User Adjustments and for Factory Adjustments.

3.1. Memory for User Adjustments

3.1.1. Adjustment

$\boxed{1}$ The memory can be updated with User Controls in User Mode.
If there are values available in the memory for user adjustments, corresponding to the present timing signals, they are always used.

3.1.2. Resetting the User Memory

$\boxed{2}$ User memory can be emptied from user made settings. Resetting affects only the timing which is currently active. The reset function is inhibited if no corresponding factory preset timing exists.

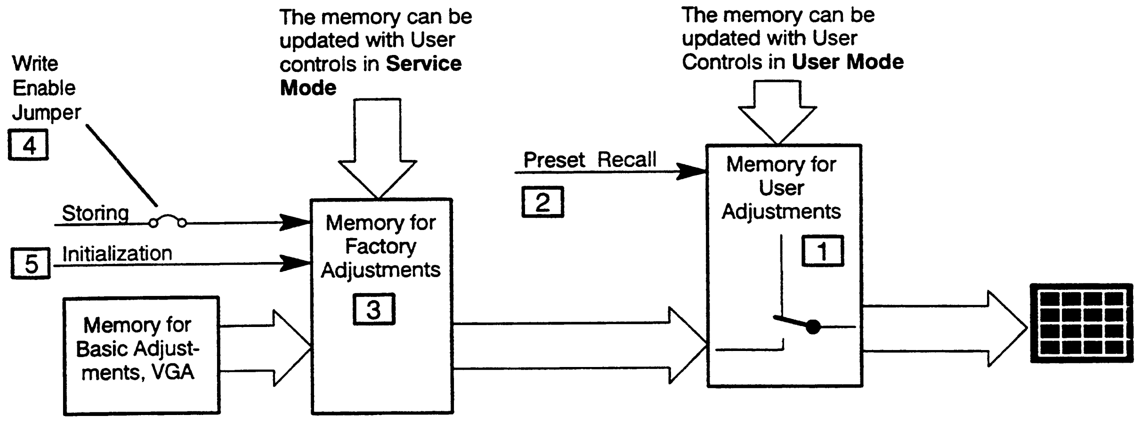
3.2. Memory for Factory Adjustments

All measures to the factory adjustments require that the write protection jumper must be connected.

3.2.1. Adjustment

$\boxed{3}$ Factory adjustments can be updated with user controls in service mode. If there is no location in factory adjustment memory for timings currently in use, the adjustment affects the memory for user adjustments.

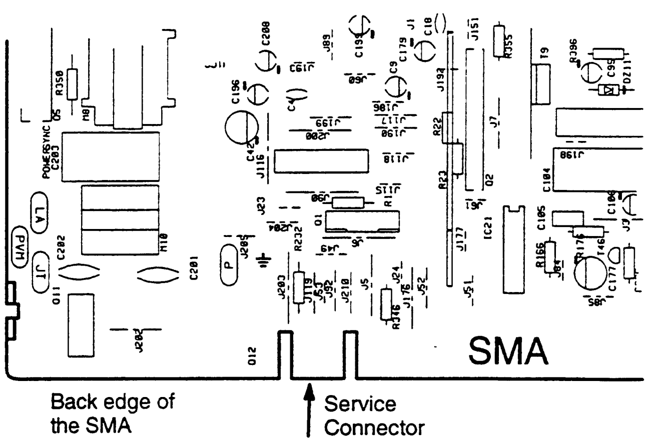
– If the memory location mentioned in case $\boxed{1}$ is empty, the picture adjustment values are read from memory for factory adjustments. Factory adjustments, corresponding to the current timings, are transferred to user memory if any picture property is adjusted. After that the operation is as in case $\boxed{1}$.

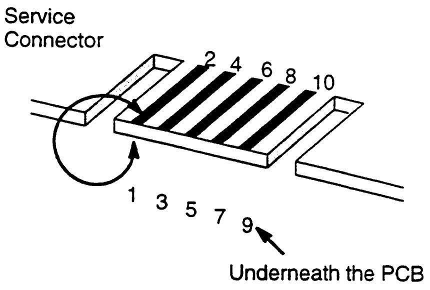

Write Enable Jumper
4
Storing
5 Initialization
Memory for Basic Adjustments, VGA
The memory can be updated with User controls in **Service Mode**
Memory for Factory Adjustments
3
Preset Recall
2
The memory can be updated with User Controls in **User Mode**
Memory for User Adjustments
1

3.2.2. Write Enable Jumper

$\boxed{4}$ Memorizing in Service Mode requires that service connector pins 1 and 2 must be short circuited. Make the short-circuit before you start the service mode and disconnect it after you have completed the whole adjustment procedure.

Note
Forgetting to disconnect the short circuit may cause corruption of the memory content during normal use.


SMA
POWERSYNC
C203
R350
C202
C201
R232
R22
C104
C105
R166
Back edge of the SMA
Service Connector


Service Connector
2 4 6 8 10
1 3 5 7 9
Underneath the PCB

3.2.3. *Initializing of the Replacement Memory (IC26 on SMA board)*

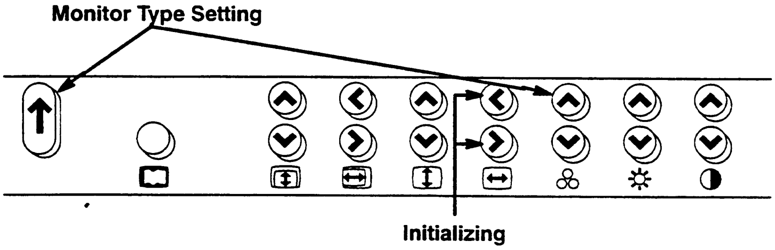
5 If replaced, the memory for factory adjustments must be initialized. During initializing the monitor type is first specified and then all memory locations are written with approximate values. They must be updated in service mode as explained in the chapter Adjustment Procedure. Before initializing, connect the Memory Enable jumper.

Monitor Type Setting

- Switch the monitor off.
- While keeping **both** monitor type setting buttons down, switch the monitor on.
- Release the buttons.

Initializing

- Switch the monitor off.
- While keeping **both** initializing buttons down, switch the monitor on.
- Release the buttons.
- Wait 20 seconds.


Monitor Type Setting
Initializing

After initializing the monitor remains in the normal user mode. Switch off the monitor and start the service mode.

Notes

- Initializing of a programmed memory IC deletes all user and factory made adjustments.

4. Service Mode

4.1. General

Service Mode is needed for updating of the factory adjustments for timings listed in the chapter Preset Display Modes. If there is no location in factory adjustment memory for display mode currently in use, the adjustment affects the memory for user adjustments.

4.2. Grouping of the Service Mode Adjustments

There are three groups of adjustments in service mode:

- 1st. geometry adjustment set: Horizontal and vertical centring, height, width, east/west, trapezoidal, rotation, horizontal and vertical convergence
- 2nd geometry adjustment set: Horizontal raster centring, east/west balance, orthogonality
- Grey scale adjustments has been divided into two subgroups
  3a: Coarse and fine black level for R and B, coarse black level for G and G2
  3b: gain for R, G and B and max/min contrast

The following table shows how the adjustments act in relation to the display modes.

Adjustment	Common for all Display modes	Separate for each Display mode	Available in User Mode	Available in Service Mode (Group Nr)
Contrast	X		X (Common memory for both modes)	
Brightness	X		X (Common memory for both modes)	
Horizontal centring		X	X	1
Vertical centring		X	X	1
Height		X	X	1
Width		X	X	1
East/west		X	X	1
Horizontal trapezoid		X	X	1
Horizontal convergence	X		X	1
Vertical convergence	X		X	1
Tilt	X		X	1
Orthogonality		X		2
East/west balance		X		2
Horizontal raster centring	X			2
R Blacklevel, coarse/fine	X			3a
G Blacklevel, coarse	X			3a
B Blacklevel, coarse/fine	X			3a
G2	X			3a
R Gain	X		X	3b
G Gain	X		X	3b
B Gain	X		X	3b
Max/Min contrast	X			3b

Common adjustments need to be adjusted only once. Separate adjustment must be performed for every display mode to be stored.

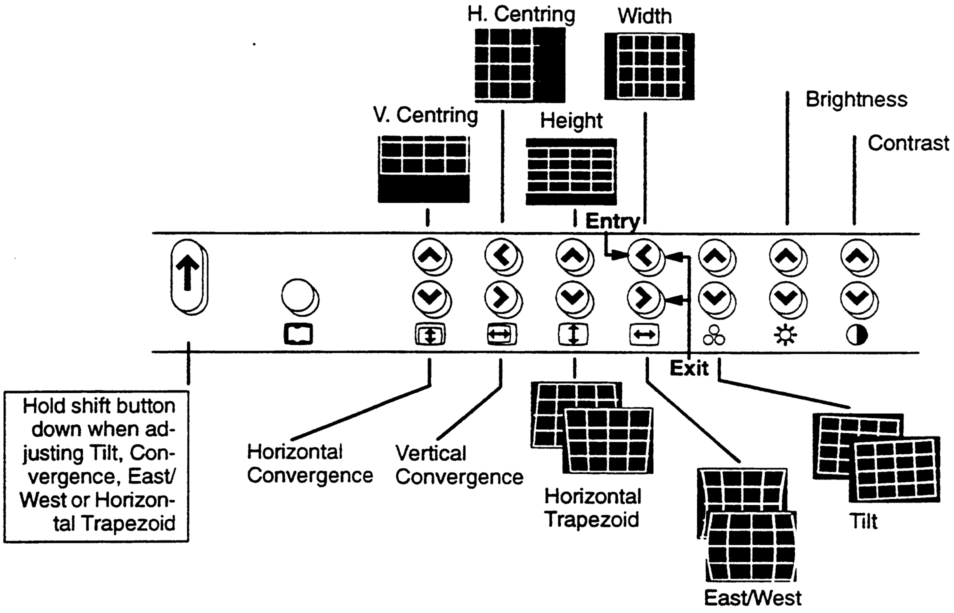
4.3. Access to the Service Mode

The groups have common control buttons. Which set is in force is fixed at the moment the service mode is activated. Brightness and contrast control buttons have always the original meaning.

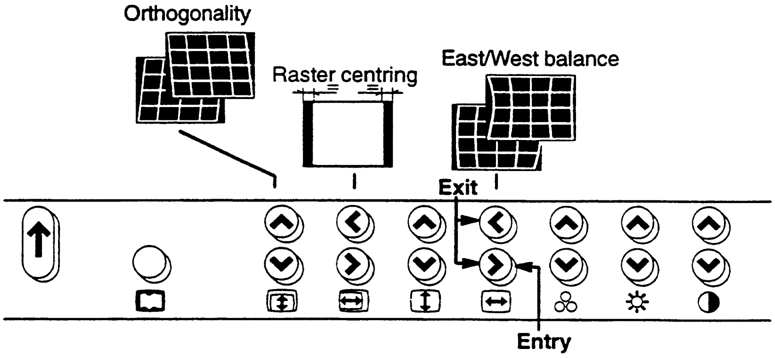
Entry to each group:
- While keeping the **Entry** button down,
- switch the monitor on.
- Release the button

Exit to the User Mode:
- Push **Exit** buttons simultaneously

4.3.1. Group 1, 1st Geometry Adjustment Set


H. Centring
Width
V. Centring
Height
Brightness
Contrast
Entry
Exit
Hold shift button down when adjusting Tilt, Convergence, East/West or Horizontal Trapezoid
Horizontal Convergence
Vertical Convergence
Horizontal Trapezoid
Tilt
East/West

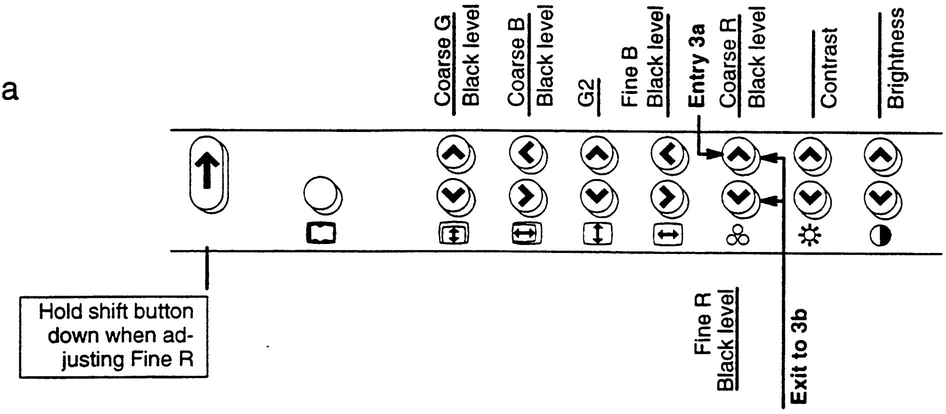
4.3.2. Group 2, 2nd Geometry Adjustment Set


Orthogonality
Raster centring
East/West balance
Exit
Entry

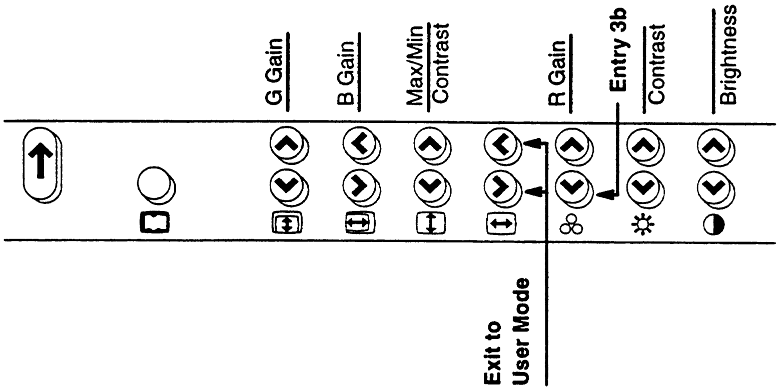
4.3.3. Group 3, Gray Scale Adjustment Set

The group has been divided into two subgroups which have separate entries but common exit. Note that there is a shortcut from 3a to 3b.

Group 3a


Coarse G
Black level
Coarse B
Black level
G2
Fine B
Black level
Entry 3a
Coarse R
Black level
Contrast
Brightness
Hold shift button down when adjusting Fine R
Fine R
Black level
Exit to 3b

Group 3b


G Gain
B Gain
Max/Min
Contrast
R Gain
Entry 3b
Contrast
Brightness
Exit to
User Mode

4.4. Storing and Returning to the User Mode

Common adjustments are stored at the moment of return to the user mode. Separate adjustments are stored automatically after each adjustment.

When you exit from Service Mode by pushing the Exit button, the monitor turns to normal user mode. If you want to leave the service mode without memorizing common adjustments, switch off the monitor in service mode.

Display modes can be changed without leaving service mode when making separate adjustments.

5. Workshop Maintenance

5.1. Important Safety Notice

The components, which are important for safety, are marked with special mark ⚠ on the circuit diagram. It is essential that these critical parts should be replaced with manufacture's specified parts to prevent X–radiation, shock, fire or other hazards.
For your own safety, use always safety isolating transformer when repairing the monitor.

5.1.1. Discharging the CRT

High voltage circuitry includes bleeder resistor which normally discharges the tube in about 5 seconds after the power is switched off. If you – for safety reasons – want to be sure about the discharging, do as follows:

Wear safety goggles. A cracked CRT may implode when discharged. The signal cable must be disconnected from the computer.

To discharge the CRT, a flat–head screwdriver with grounding cable is required.

- Make sure the power On/Off switch is in the Off position.
- Reconnect the power cable for this operation for earthing purposes.
- Connect the grounding wire to the screwdriver.
- Connect the grounding clip to the ground.
- Insert the screwdriver under the rubber cap of the EHT connector to discharge the tube.
- Disconnect the power cable.

5.2. ESD–Sensitive Parts

To prevent damage, when working with electrostatic discharge (ESD) sensitive parts, observe the following instructions:

- Keep the ESD–sensitive part in its original shipping container until you are ready to install the part into the component card.
- Just before touching the ESD–sensitive part, discharge to the monitor any static electricity in your body; do this by touching the metal frame or cover of the machine. If possible, keep one hand on the frame when inserting or removing a logic card, for example.
- Hold the ESD–sensitive part by its edge; do not touch its pins.

5.3. Test Equipment

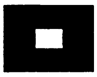
The following test equipment are required to adjustment procedure.

- Safety isolating transformer
- Digital multimeter: Fluke 87 or equivalent true RMS multimeter
- High voltage probe e.g. Fluke 80–40k
- Signal generator: Unigraph VTG220 and PC or programmable video generator
- Color analyzer: e.g. Minolta TV Color Analyzer CA100
- Convergence Gauge (e.g. Klein CM7AR)
- Hi–Pot tester (Flash tester with insulation, leakage current, break down voltage measurement)
- Oscilloscope 40–100 MHz band width

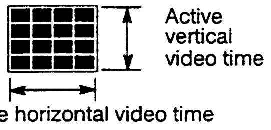
5.4. Test Patterns

1

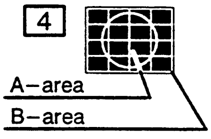
2



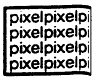
3



4



5



1 Black Picture
- Signal level = 0 V at each RGB input

2 Highlight grey scale tracking
- Signal level = 700 mV in the window at each RGB input

3 Crosshatch Picture
- Squares e.g. 20 mm x 20 mm
- Outmost lines correspond the active vertical/horizontal video time

4 Convergence test pattern

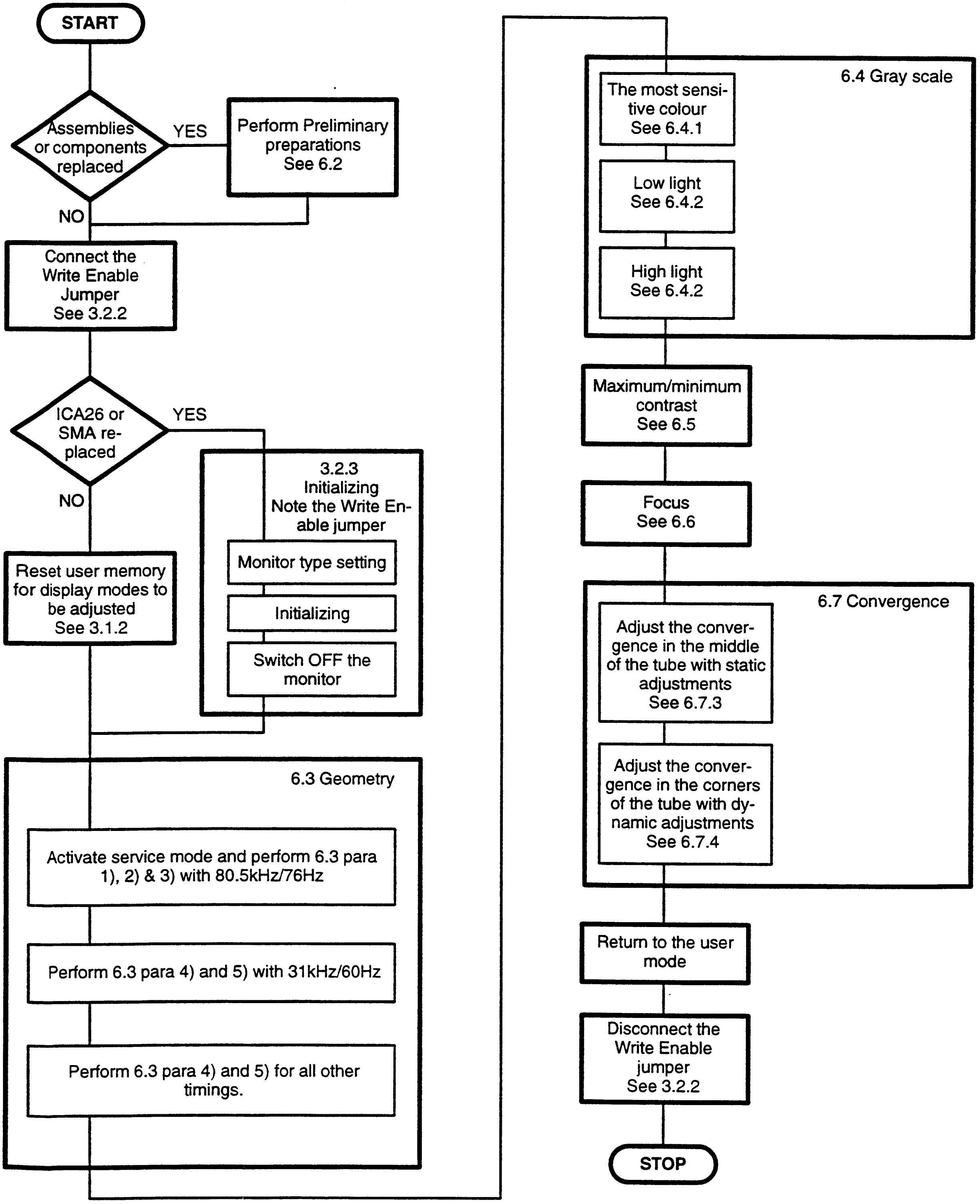
5 Focus test pattern

6. Adjustment Procedure

The following procedure must be carried out in case of large service operations e.g. when a circuit board or nonvolatile memory ICA26 has been replaced by a new one.

The order of adjustments explained here has been found to produce the desired result with the minimum of effort. Adjustments can also be made in another order or completely separately.

6.1. Adjustment Flow Diagram


START
Assemblies or components replaced
YES
Perform Preliminary preparations See 6.2
NO
Connect the Write Enable Jumper See 3.2.2
ICA26 or SMA replaced
YES
3.2.3 Initializing Note the Write Enable jumper
Monitor type setting
Initializing
Switch OFF the monitor
NO
Reset user memory for display modes to be adjusted See 3.1.2
6.3 Geometry
Activate service mode and perform 6.3 para 1), 2) & 3) with 80.5kHz/76Hz
Perform 6.3 para 4) and 5) with 31kHz/60Hz
Perform 6.3 para 4) and 5) for all other timings.
6.4 Gray scale
The most sensitive colour See 6.4.1
Low light See 6.4.2
High light See 6.4.2
Maximum/minimum contrast See 6.5
Focus See 6.6
6.7 Convergence
Adjust the convergence in the middle of the tube with static adjustments See 6.7.3
Adjust the convergence in the corners of the tube with dynamic adjustments See 6.7.4
Return to the user mode
Disconnect the Write Enable jumper See 3.2.2
STOP

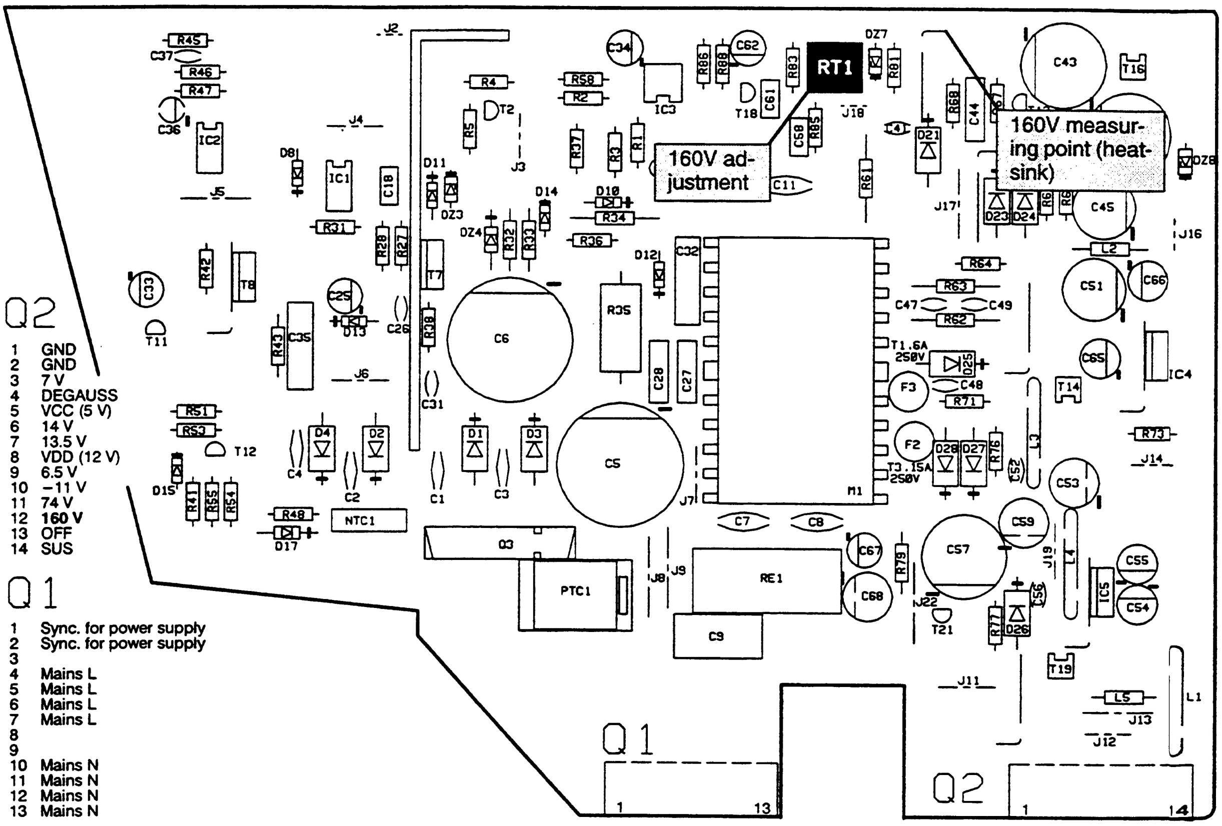
6.2. Preliminary Preparations

Connect the signal cable to the PC. Switch on the monitor and the PC. Let the monitor warm up for 20 minutes before starting the adjustments.

For your own safety, use safety isolating transformer when repairing monitor.

6.2.1. Operating Voltages

- Connect the DVM to 160 V test point. Adjust trimmer **RT1** on SMM–board for a voltage of **160.5V ±0.5V**.


RT1
160V adjustment
160V measuring point (heat-sink)
Q2
1 GND
2 GND
3 7V
4 DEGAUSS
5 VCC (5 V)
6 14 V
7 13.5 V
8 VDD (12 V)
9 6.5 V
10 −11 V
11 74 V
12 160 V
13 OFF
14 SUS
Q1
1 Sync. for power supply
2 Sync. for power supply
3
4 Mains L
5 Mains L
6 Mains L
7 Mains L
8
9
10 Mains N
11 Mains N
12 Mains N
13 Mains N
Q1
1
13
Q2
1
14

6.2.2. High Voltage *(refer to the picture on the following page)*

- Connect the high voltage meter to the anode of the picture tube.
- Adjust the high voltage to **27.0 ±0.3 kV** with **RT5** on SMA–board.

6.2.3. Sync Range Adjustment *(refer to the picture on the following page)*

This adjustment limits the line frequency range.

1) Short-circuit **Q16** pins on SMA–board.
2) Connect the frequency meter to the measuring point and GND.
3) Select a display mode with highest line frequency (80.6 kHz)
4) Adjust **RT2** on SMA–board until the meter shows a frequency=77±0.5 kHz.
5) Select a display mode with lowest line frequency (31.47 kHz)
6) Adjust **RT1** on SMA–board until the meter shows a frequency=27±0.5 kHz.

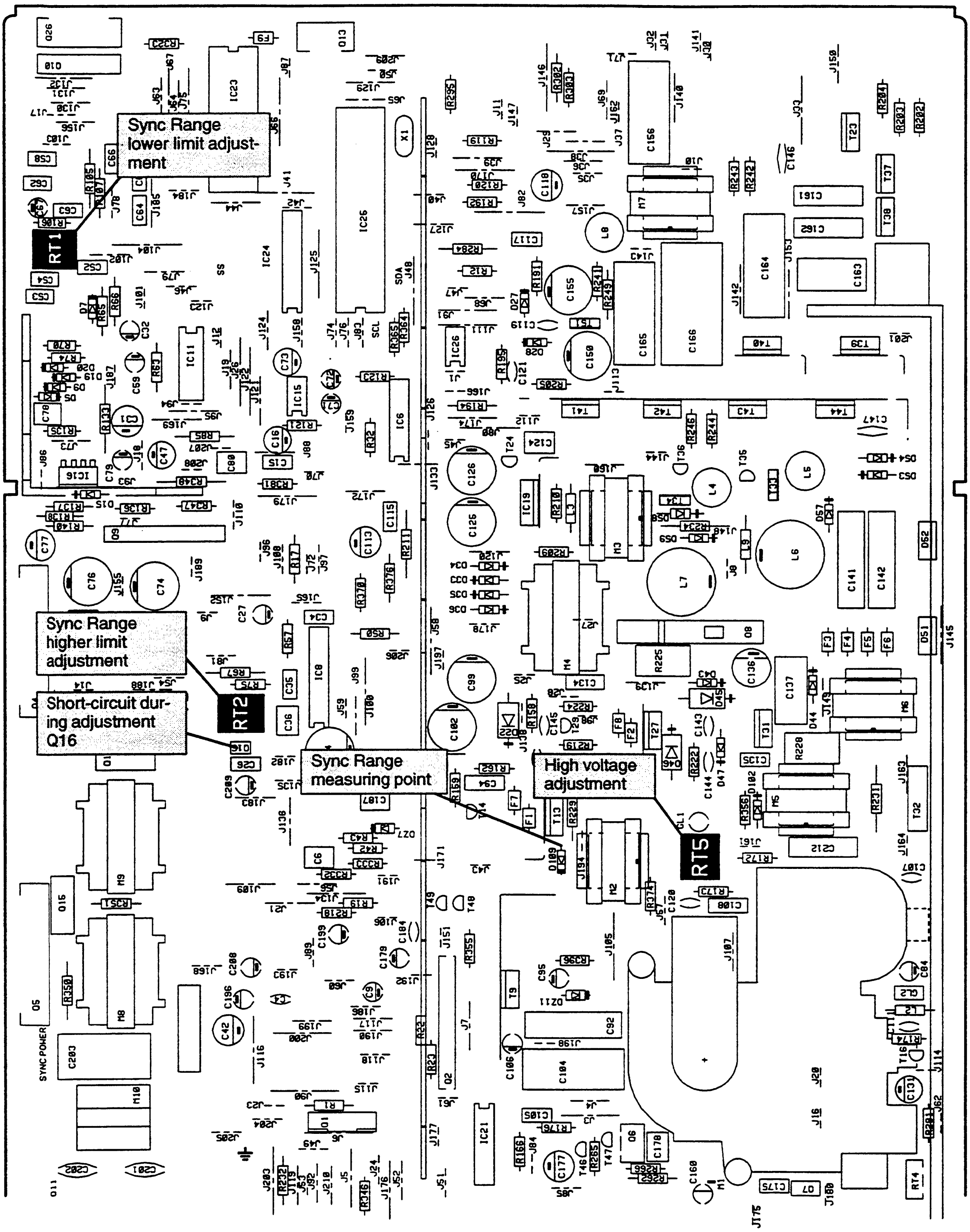
Remove the short-circuit.

6.2.4. Preliminary Picture Adjustments *(refer to the picture on the following page)*

1) Select 80.6 kHz/76 Hz crosshatch test pattern.
2) Set ◑ to maximum and adjust ☼ until the background is faintly visible.
3) Adjust convergence and focus if they are poor. See chapters Focus and Convergence.

Remember

- Do not adjust **G2** potentiometer, if you have reason to belive that there is no need to adjust gray scale.

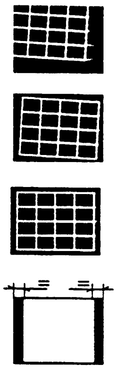

Sync Range lower limit adjustment
RT1
Sync Range higher limit adjustment
RT2
Short-circuit during adjustment Q16
Sync Range measuring point
High voltage adjustment
RT5
SYNC POWER

6.3. Geometry

Activate required service mode adjustment set as told in chapter Service Mode. Degaussing must be carried out before the picture adjustments. Degaussing shall be repeated if the monitor is moved.

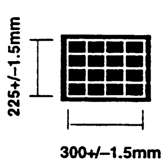
This adjustments are common for all display modes and will be stored at the moment of return to the user mode. You may have to repeat the steps several times.

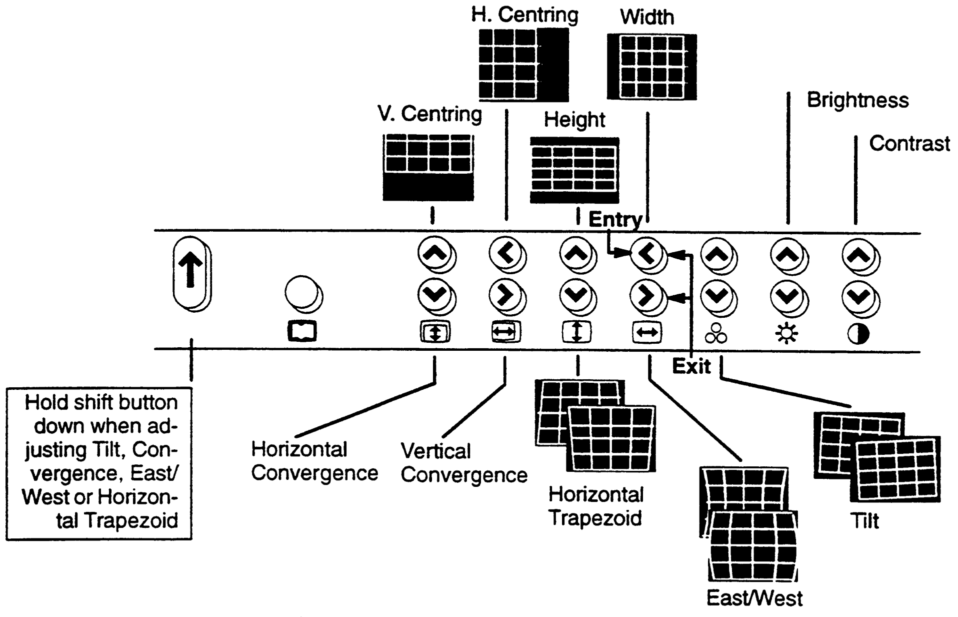
1) Select **80.6 kHz/76 Hz** crosshatch test pattern.
   Set ◑ to maximum and adjust ☼ until the background is faintly visible.
   Reduce width until both vertical edges of the **background** are visible.
2) Coarse adjustments of the picture
   Straighten the picture if tilted.
   Refer to the illustration on page 22 for **vertical trapezium** adjustment.
3) Centre the background.

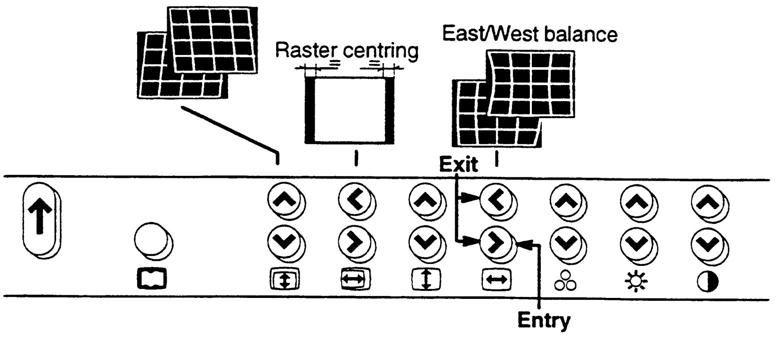


The following adjustments are separate for every display mode and will be stored at the moment of adjustment. If you have to change later common adjustments, note that it affects all display modes.

4) Select **first 31kHz/60Hz** crosshatch test pattern.
   Adjust size, position and shape of the picture equal to the mask aperture. Adjust first the properties with largest deviation from the correct value. The properties adjusted with 31kHz/60Hz are copied to every **empty** memory location. Adjusted timing modes are not affected.
5) Adjust final width and height.
6) Repeat steps 4) and 5) for every display mode to be stored. Note that the display mode can be changed without leaving the service mode.


225+/-1.5mm
300+/-1.5mm


H. Centring
Width
V. Centring
Height
Brightness
Contrast
Entry
Exit
Hold shift button down when adjusting Tilt, Convergence, East/West or Horizontal Trapezoid
Horizontal Convergence
Vertical Convergence
Horizontal Trapezoid
Tilt
East/West


Orthogonality
Raster centring
East/West balance
Exit
Entry

6.4. Grey Scale

The grey scale is adjusted for 7000K colour temperature. Memorizing takes place at the moment of return to the user mode.

6.4.1. The Most Sensitive Colour

1) Select 80.6 kHz/76 Hz black test pattern.
2) Set ☼ and ◑ to maximum.
3) Set blacklevel adjustments to minimum (for darkest picture)
4) Adjust G2 potentiometer until the background is faintly visible.

The most sensitive colour has been marked in a label on the deflection yoke. It may not be correct if tube or SMH card has been changed. In that case judge the most sensitive colour from the tone of the picture.

6.4.2. Low Light

1) Select 80.6 kHz/76 Hz black test pattern.
2) Place the probe of the colour analyzer in the middle of the screen. Activate service mode/group 3a.
3) Adjust picture brightness to 6±2 nits with G2 trimmer. Fine adjust with G2 adjustment on keypanel.
4) Adjust with ☼ the picture brightness to 2±0.5 nits.
5) Adjust the colour coordinates to (7000K)
   x = 0.303 ±0.020
   y = 0.325 ±0.020 with black level adjustments
   Do not adjust the most sensitive colour.
6) Set ☼ and ◑ to the maximum and check that the brightness is still 6±2 nits. If not, adjust with G2. Check the colour coordinates and readjust if necessary.

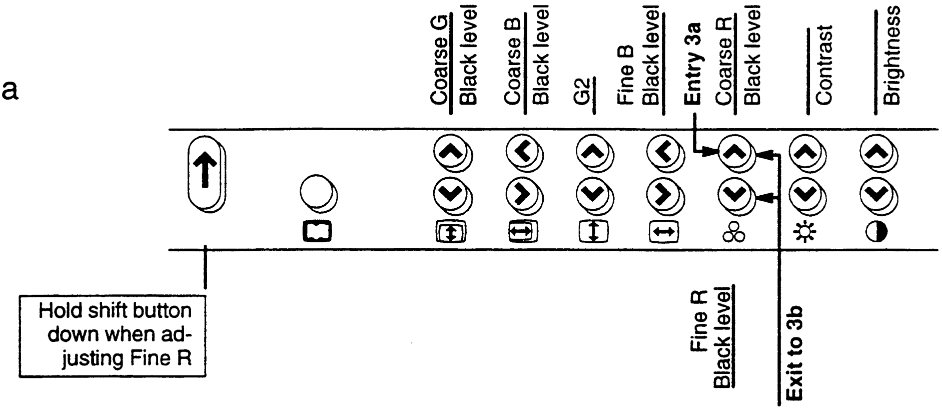
6.4.3. High Light

1) Activate service mode/group 3b.
2) Select 80.6 kHz/76 Hz black test pattern.
3) Adjust with ☼ the picture brightness to 2±0.5 nits.
4) Select 80.6 kHz/76 Hz window test pattern.
5) Set the G gain control in the middle position with the help of color analyzers brightness reading.
5) Adjust with ◑ the picture brightness in the window to 100±5 nits.
6) Adjust colour coordinates in the window to
   x = 0.303 ±0.020
   y = 0.325 ±0.020 with R and B gain. Check that the brightness reading is in limits (100±5 nits) during adjustment.

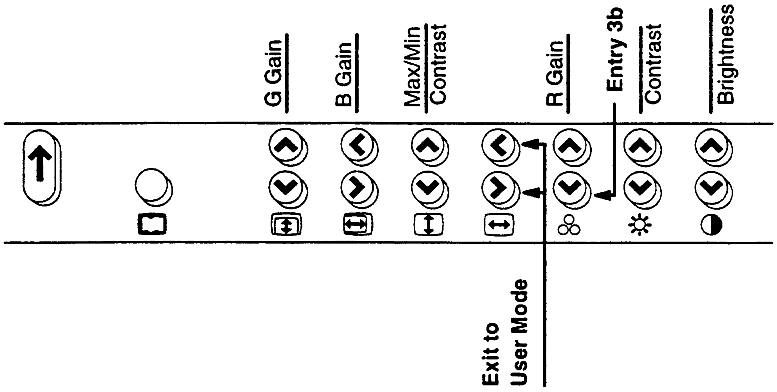
6.5. Maximum/Minimum Contrast

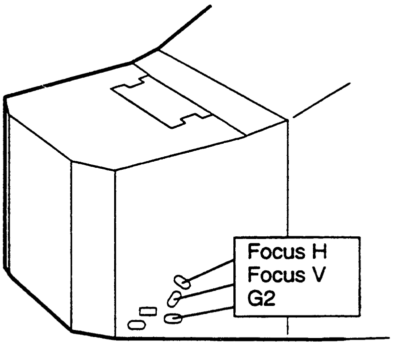
1) Set ◑ to the maximum.
2) Adjust brightness to 200±20 nits with Max/min contrast.
3) Set ◑ to minimum.
4) Adjust brightness to 10±2 nits with Max/min contrast.

Group 3a


Coarse G
Black level
Coarse B
Black level
G2
Fine B
Black level
Entry 3a
Coarse R
Black level
Contrast
Brightness
Hold shift button down when adjusting Fine R
Fine R
Black level
Exit to 3b

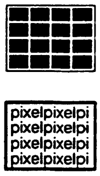
Group 3b


G Gain
B Gain
Max/Min
Contrast
R Gain
Entry 3b
Contrast
Brightness
Exit to
User Mode


Focus H
Focus V
G2

6.6. Focus

1) Select 80.6 kHz/76 Hz crosshatch test pattern
2) Set ◑ to the maximum and adjust ☼ until the background is faintly visible
3) Adjust the sharpness with **FOCUS H** and **FOCUS V** to optimum.
4) Adjust ☼ until the background is invisible
5) Select focus test pattern. Check that all letters are clearly visible

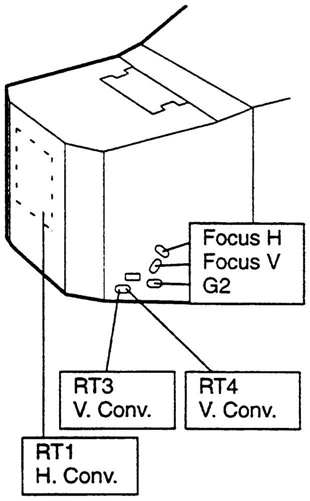

pixelpixelpi
pixelpixelpi
pixelpixelpi
pixelpixelpi

6.7. Convergence

Reduce first the convergence error in the middle of the screen to minimum using static adjustments. After the convergence is faultless in the middle of the tube, use dynamic adjustments to eliminate the error in the edges of the tube.

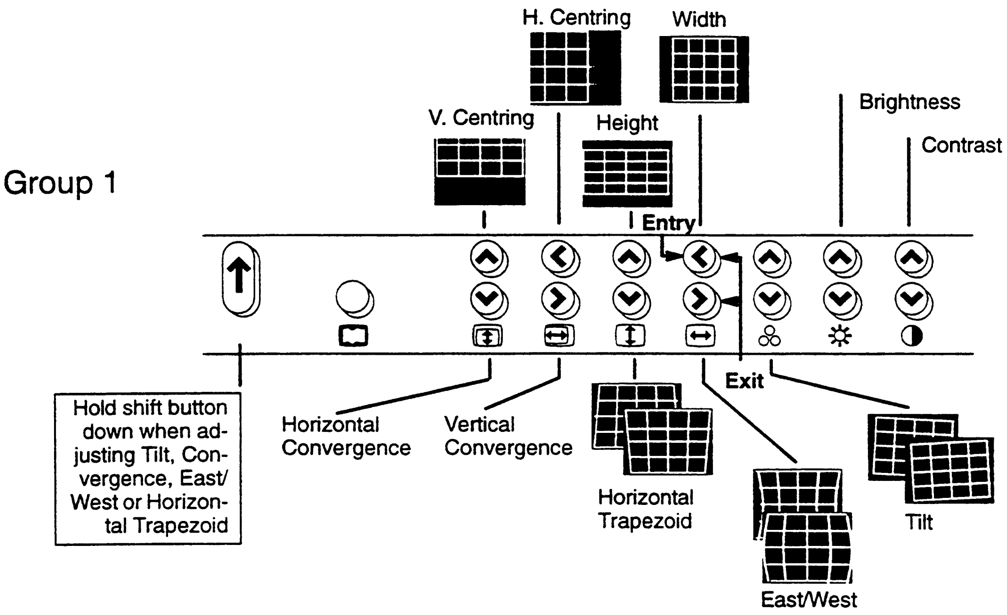
Static adjustments affects the whole picture area:
- keypanel buttons (horizontal + vertical)
- magnet ring set on the tube neck (horizontal + vertical)
- RT1 on the SMH–board (coarse horizontal)

Dynamic adjustments affects a part of the picture area:
- RT3 and RT4 on SMA–board
- deflection yoke trimmers.


Focus H
Focus V
G2
RT3
V. Conv.
RT4
V. Conv.
RT1
H. Conv.

6.7.1. Measuring Conditions

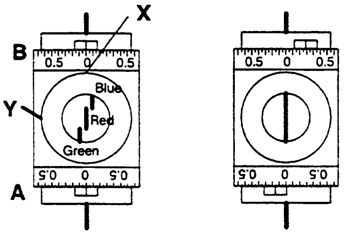
- Adjust convergence with 61.8 kHz line frequency
- Make sure that focus is correctly set at the mid-point between the screen center and the edge of the picture.
- Use white crosshatch test pattern with circle.
- Adjust ◑ to near the maximum and reduce ☼ until the background disappears.


Group 1
H. Centring
Width
V. Centring
Height
Brightness
Contrast
Entry
Exit
Hold shift button down when adjusting Tilt, Convergence, East/West or Horizontal Trapezoid
Horizontal Convergence
Vertical Convergence
Horizontal Trapezoid
Tilt
East/West

Convergence Measuring Gauge CM7AR

The use of the Klein CM7AR Convergence Gauge has been explained here but other types of gauges can be used as well.

Check that the adjusting knobs (A & B) are set to zero.
- Place the gauge on the line with marking **Y up** upwards when measuring horizontal line.
- Place the gauge on the line with marking **X up** upwards when measuring vertical line.
- If the line has convergence error, the line in the window seems to be broken.
- Use knobs A and B to adjust the line continuous.
- If the readings are on the opposite side of zero, the convergence error is A+B (e.g. 0.2 + 0.1 = 0.3).
- If the readings are on the same side of zero, the convergence error is equal to A if A > B or B if B > A


X
B
Y
A
0.5
0
0.5
Blue
Red
Green
0.5
0
0.5

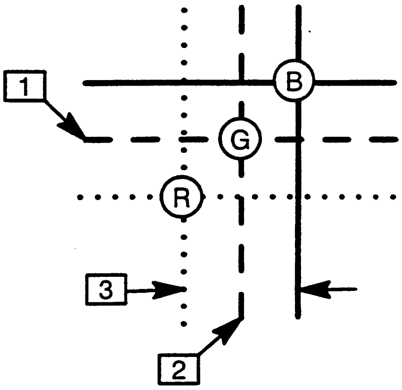
6.7.2. Static Convergence

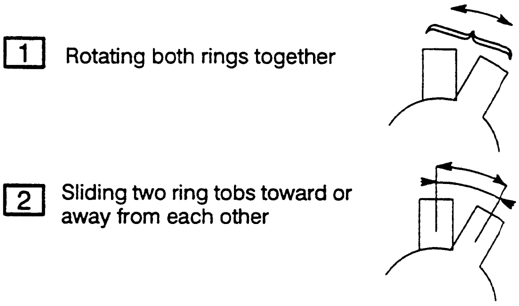
The magnet rings has been set to the optimum in the factory. Readjustment is necessary only in case the adjusting magnets have been accidentally moved. Activate required group of service mode adjustments.

1 Adjust G vertically in the middle between R and B.
2 Adjust G horizontally in the middle between R and B.
3 Adjust R and B to the same position with G line using **RT1** on the SMH–board.

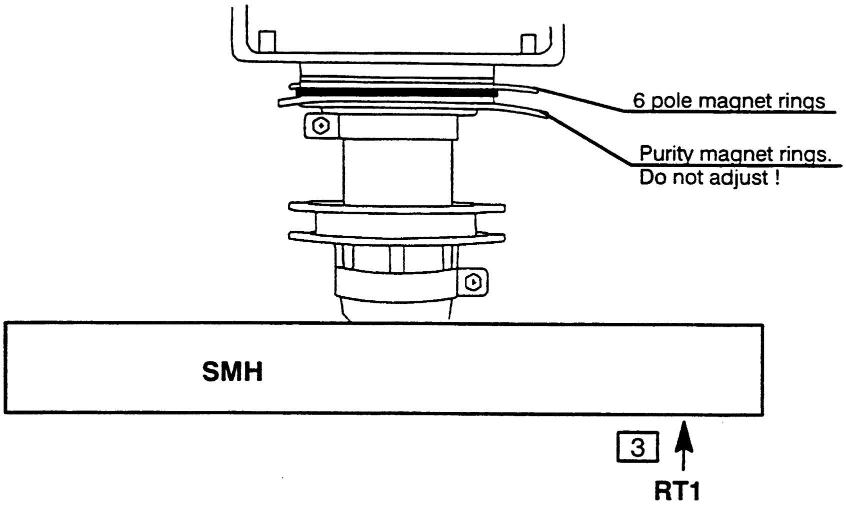
Fine adjust convergence with the buttons in the keypanel. When adjusting RT1, take into account that the keypanel adjustments must have margin on both sides of optimum.

Lock the rings with paint.



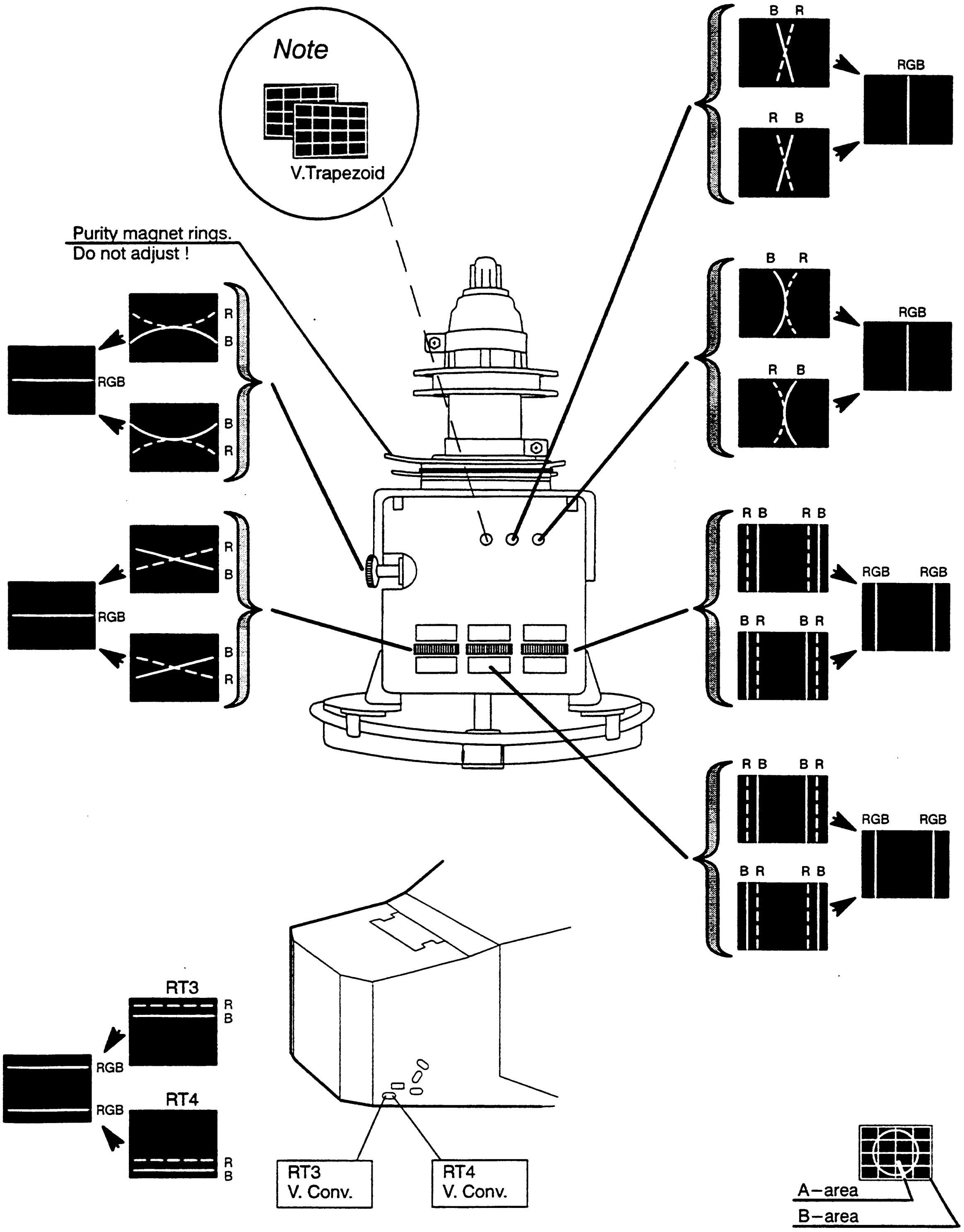

1 Rotating both rings together

2 Sliding two ring tobs toward or away from each other


6 pole magnet rings

Purity magnet rings. Do not adjust !

6.7.3. Dynamic Convergence

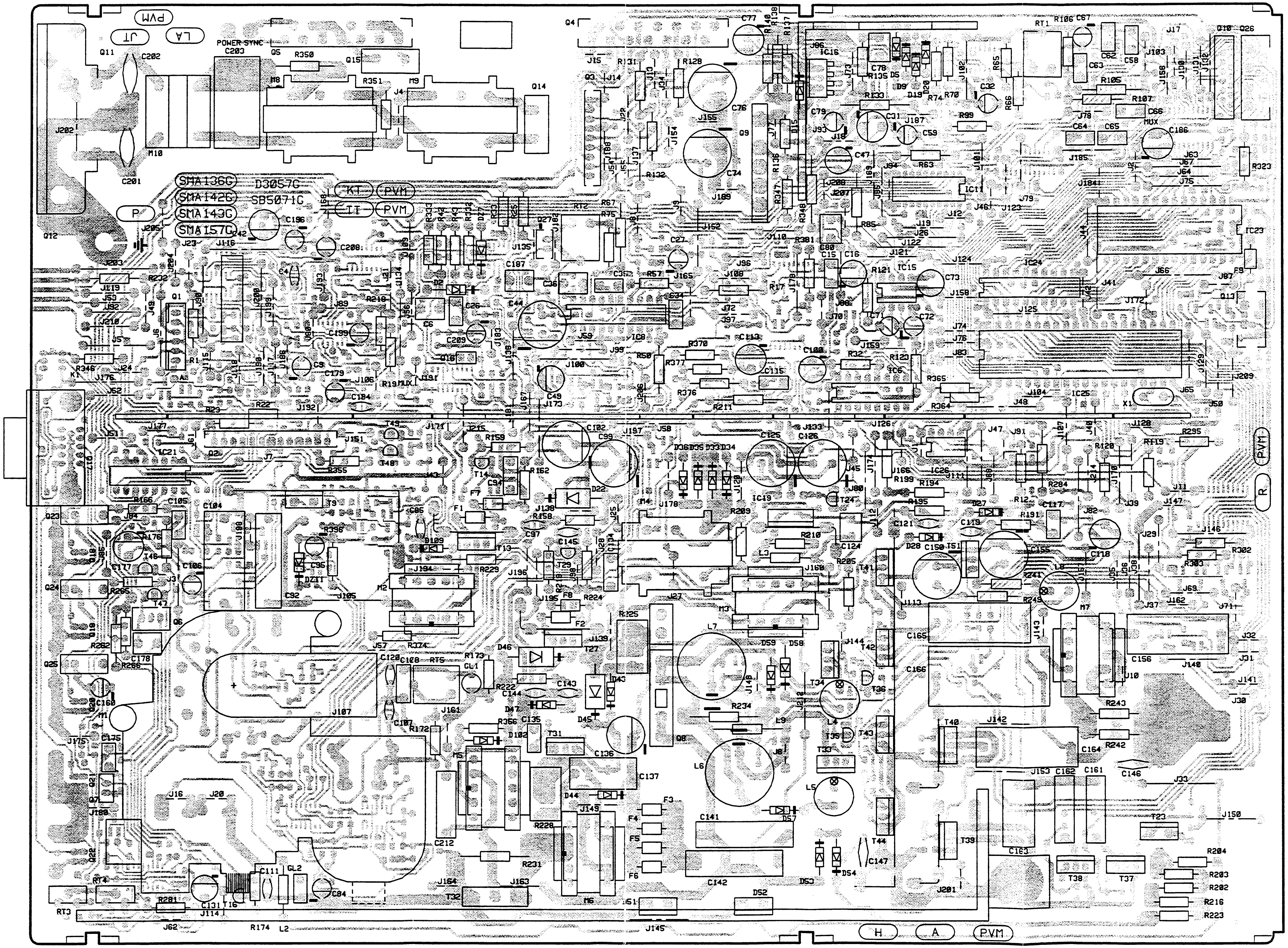

Note
V.Trapezoid
Purity magnet rings.
Do not adjust !
B R
R B
RGB
R B
B R
RGB
R B R B
B R B R
RGB RGB
R B B R
B R R B
RGB RGB
RT3
R
B
RGB
RGB
RT4
R
B
RT3
V. Conv.
RT4
V. Conv.
A–area
B–area

6.7.4. Allowed Error Levels for Convergence

Area A: ≤ 0.3 mm
Area B: ≤ 0.4 mm

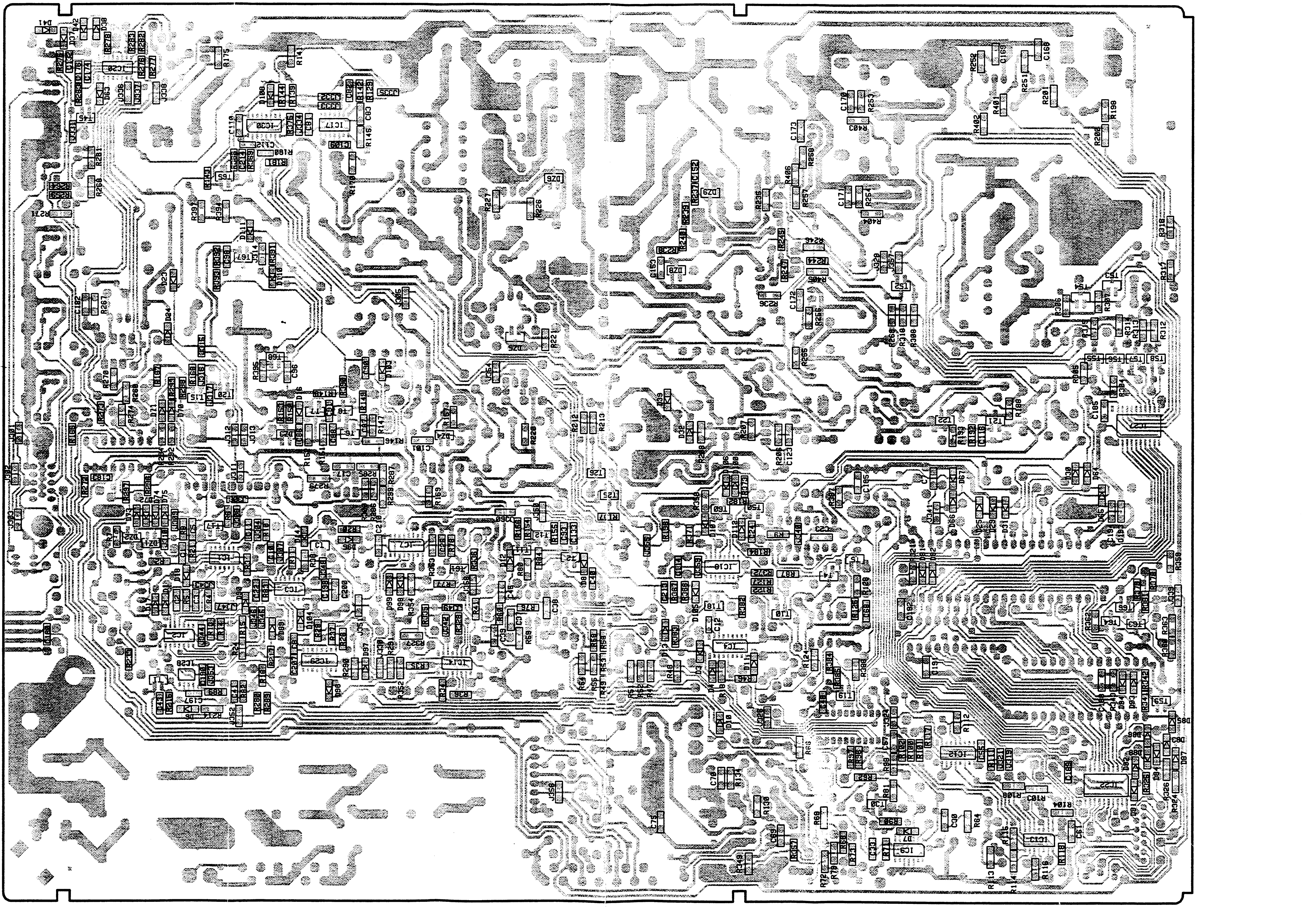
6.8. Colour Purity

Do not move purity magnet rings. If the purity magnet rings are found to have moved during transportation or handling, set them just in the original position by tracing the locking paint put on purity magnet rings and holder of beam bender and then readjust the static convergence.


PVM
JT
LA
POWER SYNC
SMA136G
SMA142G
SMA143G
SMA157G
D3057G
SB5071C
KT
PVM
TI
PVM
P
PVM
R
H
A
PVM

SMA142G

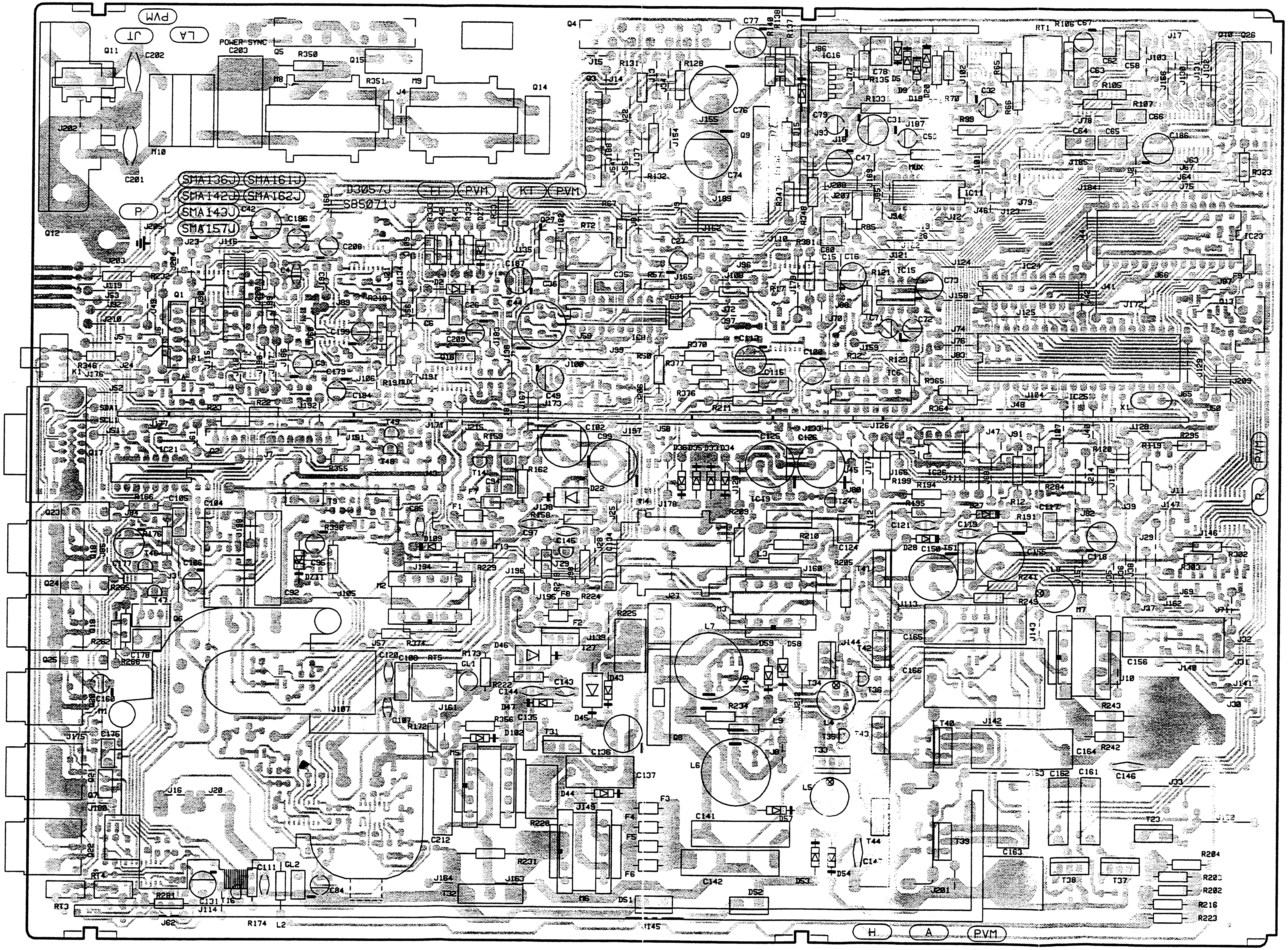
D3062G 01.95 Page 1



Part Number	Description	PG		Item Number
AA0643	CF RES 0W25 56R J	1	R	210
AA0649	CF RES 0W25 100R J	1	R	119 232 032 284 295 323 120 347 348
AA0653	CF RES 0W25 150R J	1	R	173
AA0665	CF RES 0W25 470R J	1	R	229 211 050
AA0667	CF RES 0W25 560R J	1	R	063
AA0669	CF RES 0W25 680R J	1	R	377
AA0673	CF RES 0W25 1K0 J	1	R	012
AA0681	CF RES 0W25 2K2 J	1	R	022 123 121 023
AA0689	CF RES 0W25 4K7 J	1	R	364 365
AA0697	CF RES 0W25 10K J	1	R	017 085
AA0703	CF RES 0W25 18K J	1	R	033
AA0703	CF RES 0W25 18K J	1	R	019
AA0713	CF RES 0W25 47K J	1	R	302 303 099 381
AA0721	CF RES 0W25 100K J	1	R	133
AA0725	CF RES 0W25 150K J	1	R	107
AA0745	CF RES 0W25 1M0 J	1	R	218 174
AB0593	NF RES 0W25 0R47 J CF	1	R	135 162 224
AB0609	NF RES 0W25 2R2 J CF	1	R	209 266
AB0625	NF RES 0W25 10R J CF	1	R	265
AB0633	NF RES 0W25 22R J CF	1	R	262
AB0649	NF RES 0W25 100R J CF	1	R	158 222 370
AB0803	NF RES 0W5 1R2 J CF	1	R	128
AB0809	NF RES 0W5 2R2 J CF	1	R	131 132
AB0835	NF RES 0W5 27R J CF	1	R	249
AB0839	NF RES 0W5 39R J CF	1	R	241
AC3550	CHIPRES 0W1 33K 1%	1	R	180
AC8625	CHIPRES 0W12 10R J	1	R	155 156 212 213 227 235 236 153 150 080
AC8633	CHIPRES 0W12 22R J	1	R	270
AC8649	CHIPRES 0W12 100R J	1	R	327 367 321 269 251 252 253 254 255
AC8649	CHIPRES 0W12 100R J	1	R	256 257 258 290 296 297
AC8649	CHIPRES 0W12 100R J	1	R	324 325 353 326 363
AC8657	CHIPRES 0W12 220R J	1	R	002 007 397 360
AC8659	CHIPRES 0W12 270R J	1	R	076
AC8659	CHIPRES 0W12 270R J	1	R	088
AC8665	CHIPRES 0W12 470R J	1	R	083 154 021
AC8667	CHIPRES 0W12 560R J	1	R	394
AC8667	CHIPRES 0W12 560R J	1	R	075
AC8673	CHIPRES 0W12 1K0 J	1	R	024 354 337 081 146 263 188 208 217
AC8673	CHIPRES 0W12 1K0 J	1	J	337
AC8673	CHIPRES 0W12 1K0 J	1	R	025
AC8675	CHIPRES 0W12 1K2 J	1	R	052 134 349 009 010
AC8677	CHIPRES 0W12 1K5 J	1	R	198 293 261 342 267
AC8681	CHIPRES 0W12 2K2 J	1	R	318 086 104 111 114 118 314 315
AC8681	CHIPRES 0W12 2K2 J	1	R	144 148 292 294 312 313 316 317 343
AC8681	CHIPRES 0W12 2K2 J	1	R	084 358 373 184
AC8683	CHIPRES 0W12 2K7 J	1	R	369 089 220
AC8685	CHIPRES 0W12 3K3 J	1	R	182 215 181
AC8685	CHIPRES 0W12 3K3 J	1	R	031
AC8689	CHIPRES 0W12 4K7 J	1	R	038 041 046 152 006 259 233 336 341 352
AC8689	CHIPRES 0W12 4K7 J	1	R	064 201 386 387 260 247 391 359
AC8689	CHIPRES 0W12 4K7 J	1	R	378 169 392 401 402 403 404 405 406
AC8689	CHIPRES 0W12 4K7 J	1	R	207
AC8693	CHIPRES 0W12 6K8 J	1	R	029 383 368
AC8695	CHIPRES 0W12 8K2 J	1	R	143 283 151 073 393 291 011
AC8697	CHIPRES 0W12 10K J	1	R	014 026 244 285 078 336 246 206 245
AC8697	CHIPRES 0W12 10K J	1	R	125 157 003 008 221 226 200
AC8697	CHIPRES 0W12 10K J	1	R	276 277 278 366 385
AC8697	CHIPRES 0W12 10K J	1	J	336
AC8697	CHIPRES 0W12 10K J	1	R	020 030
AC8699	CHIPRES 0W12 12K J	1	R	071 271 016
AC8701	CHIPRES 0W12 15K J	1	R	192 097 371 375
AC8703	CHIPRES 0W12 18K J	1	R	117 124 147 395
AC8705	CHIPRES 0W12 22K J	1	R	015 018 384 077 079 372 214 390
AC8705	CHIPRES 0W12 22K J	1	R	230
AC8707	CHIPRES 0W12 27K J	1	R	098 122 127
AC8709	CHIPRES 0W12 33K J	1	R	034 100 062 139 141 049 145 165 193
AC8711	CHIPRES 0W12 39K J	1	R	047 051 053
AC8713	CHIPRES 0W12 47K J	1	R	087 149 130 103 112 115
AC8713	CHIPRES 0W12 47K J	1	R	308 273 304 305 306 307
AC8715	CHIPRES 0W12 56K J	1	R	072
AC8717	CHIPRES 0W12 68K J	1	R	082 102 361 362 379
AC8719	CHIPRES 0W12 82K J	1	R	282 268 068 069 090 264
AC8721	CHIPRES 0W12 100K J	1	R	004 096 170 272 126 196 382 237 238
AC8721	CHIPRES 0W12 100K J	1	R	167 275 328
AC8723	CHIPRES 0W12 120K J	1	R	035 239 056 197 240 288
AC8725	CHIPRES 0W12 150K J	1	R	013 037 274 108 113 116 054 058
AC8731	CHIPRES 0W12 270K J	1	R	101 048 288
AC8733	CHIPRES 0W12 330K J	1	R	357 280 055
AC8737	CHIPRES 0W12 470K J	1	R	168 289
AC8745	CHIPRES 0W12 1M0 J	1	R	005 036 175 059 060 335 129 142
AC8755	CHIPRES 0W12 2M7 J	1	R	299 300
AC8755	CHIPRES 0W12 2M7 J	1	R	028
AC8761	CHIPRES 0W12 4M7 J	1	R	286 287
AC8799	CHIPRES 0W12 0R0	1	J	301 302 303 304 305 306 307 308 309 310
AC8799	CHIPRES 0W12 0R0	1	J	311 312 313 314 315 316 319
AC8799	CHIPRES 0W12 0R0	1	J	321 358 359 324 325 329 330
AC8799	CHIPRES 0W12 0R0	1	J	331 332 333 334 335 338 339 340
AC8799	CHIPRES 0W12 0R0	1	J	341 342 343 344 345 346 347 348 349 350
AC8799	CHIPRES 0W12 0R0	1	J	351 352 353 354 355 356 357 360
AD0395	COMP RES 0W5 6K8 K	2	R	242 243
AD0445	COMPRES 0W5 1M0 K	1	R	351
AG3101	MF RES 0W5 1R00 F	1	R	137 138
AG3119	MF RES 0W5 1R54 F	1	R	140
AG3319	MF RES 0W5 154R F	1	R	356
AG3333	MF RES 0W5 215R F	1	R	205 195
AG3343	MF RES 0W5 274R F	1	R	106 136
AG3351	MF RES 0W5 332R F	1	R	001 346
AG3357	MF RES 0W5 383R F	1	R	105
AG3373	MF RES 0W5 562R F	1	R	199
AG3409	MF RES 0W5 1K21 F	1	R	194
AG3433	MF RES 0W5 2K15 F	1	R	066
AG3451	MF RES 0W5 3K32 F	1	R	065 333
AG3457	MF RES 0W5 3K83 F	1	R	042
AG3465	MF RES 0W5 4K64 F	1	R	067
AG3481	MF RES 0W5 6K81 F	1	R	191
AG3489	MF RES 0W5 8K25 F	1	R	332 043
AG3501	MF RES 0W5 10K0 F	1	R	376 281
AG3509	MF RES 0W5 12K1 F	3	R	355
AG3533	MF RES 0W5 21K5 F	1	R	057
AG3551	MF RES 0W5 33K2 F	1	R	070
AG3565	MF RES 0W5 46K4 F	1	R	074
AG3573	MF RES 0W5 56K2 F	1	R	166
AG3601	MF RES 0W5 100K F	1	R	202 203 216
AG3609	MF RES 0W5 121K F	1	R	172 176 223
AG3633	MF RES 0W5 215K F	1	R	374 396
AG3657	MF RES 0W5 383K F	1	R	219
AG3689	MF RES 0W5 825K F	1	R	159
AG3701	MF RES 0W5 1M00 F	1	R	204
AJ0013	WW RES 2W0 0R22 K FP	4	RY	350
AJ0103	WW RES 5W0 3R3 K	4	RY	225
AJ0102	WW RES 5W0 4R7 K	4	RY	228
AJ2663	MO RES 2W0 39R J	2	RY	231
AJ2823	MO RES 2W0 180R J	2	RY	234
AQ2213	TPMET.AA H10 470R	3	RT	002
AQ2219	TPMET.AA H10 47K	3	RT	005
AQ2347	TPMET. H10 10K	4	RT	001
AQ2435	TPMET. V10 2K2	3	RT	003 004
CA0318	CERCAP 680P M	2	C	147 146
CA0322	CERCAP 2N2 K	2	C	111
CA0324	CERCAP 100P K 1KV	2	C	120
CB0531	CERCAP 47P J 50V	1	C	085
CB0673	CERCAP 100P J 50V	1	C	144 145
CB3059	CHIPCAP 220P G 50V	2	C	012 112 197
CB3059	CHIPCAP 220P G 50V	2	C	181
CB4131	CHIPCAP 18P J 50V	2	C	193 194
CB4141	CHIPCAP 47P J 50V	2	C	087 210 001 005
CB4151	CHIPCAP 100P J 50V	2	C	101 011 116 023 083 109 180 190 069 070
CB4151	CHIPCAP 100P J 50V	2	C	040
CB4167	CHIPCAP 470P J 50V	2	C	082 200 213 214 022
CC0110	CERCAP 150P K 500V	1	C	097 143
CC0140	CERCAP 270P K 500V	1	C	184
CC0170	CERCAP 470P K 500V	1	C	004 107
CC0772	CERCAP 10N Z 50V	1	C	119 121
CC4200	CHIPCAP 1N0 K 50V	1	C	007 090 088 091 176
CC4280	CHIPCAP 4N7 K 50V	2	C	123
CC4320	CHIPCAP 10N K 50V	2	C	003 008 030 037 038 017 098
CC4855	CHIPCAP 100N Z 50V	3	C	002 010 169 024 025 033 041 045 048
CC4855	CHIPCAP 100N Z 50V	3	C	055 170 057 061 068 081 086 093 114 132
CC4855	CHIPCAP 100N Z 50V	3	C	133 152 153 174 171 182 183 185 188 189
CC4855	CHIPCAP 100N Z 50V	3	C	191 192 195 198 207 172 039 043 075 168
CC4855	CHIPCAP 100N Z 50V	3	C	096 110 173
CE0081	X2–CAP 220N K 250VAC	8	C	203
CE0116	Y–CAP 2N2 M 400VAC	4	C	201 202
CE2004	IMPCAP 100P K 1K6V	3	C	212
CE2234	IMPCAP 3N3 K 1K5V	4	C	092
CE2363	IMPCAP 10N J 1K25V	6	C	141 142
CE2802	IMPCAP 51N J 400V	3	C	161
CE2933	IMPCAP 100N K 400V	4	C	162 137
CE3020	IMPCAP 220N J 250V	3	C	163
CE3064	IMPCAP 330N J 400V	7	C	156
CE3088	IMPCAP 400N J 250V	7	C	104
CE3113	IMPCAP 470N J 250V	5	C	164
CE3203	IMPCAP 1U0 J 250V	7	C	165
CE3292	IMCAP 2U2 J 250V	12	C	166
CG2541	PPRCAP 1N5 H 63V	3	C	115
CG2717	PPRCAP 10N H 63V	3	C	036
CK1388	PESCAP 10N K 250V	2	C	094 134 108
CK2384	PESCAP 10N K 63V	2	C	026
CK2627	PESCAP 100N K 63V	2	C	015 034 035 058 064 105 135
CK2663	PESCAP 150N J 63V	3	C	117
CK2704	PESCAP 220N K 63V	3	C	062 066 175 065 063
CK2784	PESCAP 470N K 63V	3	C	006 080 078
CK2864	PESCAP 1U0 K 50V	5	C	124 178
CN0126	ELCAP 0U47 M 50V	1	C	079 032
CN0154	ELCA 1U0 M 50V	1	C	209
CN2566	ELCAP 4U7F M 50V	2	C	095
CN0250	ELCAP 4U7 M 35V	2	C	179

Part Number	Description	PG	Item Number
CN0308	ELCAP 10U M 50V	1	C 027 067 071 072 131 187 059 084
CN0308	ELCAP 10U M 50V	1	C 160
CN0320	ELCAP 10U M 25V	2	C 196 199 208
CN0370	ELCAP 22U M 16V	2	C 009
CN0372	ELCAP 22U M 50V	3	C 009 016
CN0423	ELCAP 47U M 50V	2	C 047 031
CN0519	ELCAP 220U M 16V	2	C 049
CN2044	ELCAP 10U M 350V	7	C 150
CN2226	ELCAP 2U2 M 350V	3	C 155
CN2467	ELCAP' 47U M 200V	5	C 099 102
CN2539	ELCAP 100U M 50V	3	C 042 073 077 113 118 177 100
CN2539	ELCAP 100U M 50V	3	C 186
CN2563	ELCAP 2U2F M 50V	2	C 106
CN2712	ELCAP 1000U M 16V	5	C 125 126 136 044
CN2749	ELCAP 2200U M 16V	4	C 074 076
FJ0429	CHOKE 33UH 10%	4	L 003
FJ0505	CHOKE 15UH 5%	2	L 002
FJ0725	BEAD INDUCTOR 360HM	2	F 003 006 001 002 004 005 007 008 009
FJ0728	LEAD INDUCTOR 1000UH 10%	5	L 008
FJ0729	LEAD INDUCTOR 150UH 10 %	7	L 004
FJ0705	CHOKE 330UH	2	L 009
FJ0731	LEAD INDUCTOR 100UH 10%	7	L 005
FJ0800	EMI/RFI CHOKE 60MH 3A(AC)	14	M 010
FJ1826	INPUT CHOKE E30/7 2X7,8 MH	12	M 008 009
FM0623	FLYBACK TRAFO 30...82KHZ	44	M 001
FM2520	INPUT COIL E30 1M35H	14	M 004
FM2521	DRIVER TRAFO E20/6	12	M 006
FM2522	DYNAMIC FOCUS TRAFO E20/6	13	M 007
FM2525	CENTERING COIL E20/6	11	M 003
FM2529	PARALLEL COIL 20/6	12	M 005
FM2540	CHOKE 20/6	12	M 002
FU0707	FIXED LINEARITY COIL S–N	13	L 006
FU0708	FIXED LINEARITY COIL N–S	13	L 007
JF0025	DI 1N4148 75V 200MA	1	D 002 009 019 020 109 005
JF0032	DI UF4007 1000V 1A 75N DO41/SOD57	4	D 053 054
JF0033	DI UF5404 400V 3A 50NS	4	D 022 045 046
JF0060	DI 1N4002 100V 1A	1	D 015 043
JF0072	DI BAV21 200V 250MA 50N	1	D 027 028
JF0073	DI RGP10G 400V 1A 150N	4	D 033 034 035 036 047 057 102 058
JF0073	DI RGP10G 400V 1A 150N	4	D 059
JF0106	DI UF2D–7000 200V 2A 50N	3	D 044
JF0165	DIODE BY359 1500V 5A	13	D 051 052
JF4005	DI LL4148 75V 150MA	1	D 001 007 003 004 090 006 039 008 081 010
JF4005	DI LL4148 75V 150MA	1	D 011 031 013 014 016 083 029 030 023 024
JF4005	DI LL4148 75V 150MA	1	D 025 032 037 038 041 042 063 064 065 066
JF4005	DI LL4148 75V 150MA	1	D 067 071 072 073 074 075 012 107 108 082
JF4005	DI LL4148 75V 150MA	1	D 085 086 087 088 089 084 091 092 093 094
JF4005	DI LL4148 75V 150MA	1	D 095 096 097 098 099 110 111 103 104 105
JF4005	DI LL4148 75V 150MA	1	D 070 017 018 112 100 106
JF4005	DI LL4148 75V 150MA	1	D 040
JH0064	ZDI BZX83C9V1 9.1V 0.5W 5%	3	DZ 011
JH0169	ZDI BZX55B3V9 3,9V 0,5W 2%	3	DZ 007
JH4118	ZDI BZX84C12 12V 0.35W 5%	2	DZ 001 003 004 005 006 008 009 002
JM0205	TR BF423 P 250V 25MA	3	T 014 029
JM0239	TR BC638 P 60V 1A	4	T 047
JM0244	TR BF422 N 250V 25MA	2	T 016 024 035 036 048 049
JM0255	TR BC637–6/–10 N 60V 1A	4	T 046
JM0310	TR 2SC4152 1500V 0.1A	8	T 023
JM0341	TR BUH1215(435B) N 1500V 19A TO218	19	T 032
JM4105	TR BC847B N 45V 0.1A SOT23	2	T 002 003 004 005 006 007 008 011 010 025
JM4105	TR BC847B N 45V 0.1A SOT23	2	T 064 019 053 054 055 056 057 058 050 066
JM4105	TR BC847B N 45V 0.1A SOT23	2	T 017 052 068 030
JM4114	TR BC857B P 45V 100MA	2	T 001 012 015 021 022 026 045 059 060
JM4114	TR BC857B P 45V 100MA	2	T 063 018 065 020 067 061
JM4114	TR BC857B P 45V 100MA	2	T 069
JS0019	FET IRF640 N 200V 18A TO220	13	T 041 042 043 044
JS0019	FET IRF640 N 200V 18A TO220	13	T 039 040
JS0026	FET IRFBC40 N 600V 6.0A TO220 AB	10	T 009
JS0030	FET IRF620 200V 5A 0.8R TO–220	7	T 037 038 051
JS0037	FET IRFU320 N 400V 3.1A 1.8R	11	T 033 034
JS0051	FET IRF9540 P 100V 19A 0.2R TO220	14	T 031
JS0057	FET IRF9622 P 200V 2R4 3A TO–220	9	T 013 027
JZ0005	SILICONE INSUL. PAD 19*13*0.22MM	1	T 041 042 043 044 009 013 027
JZ0005	SILICONE INSUL. PAD 19*13*0.22MM	1	IC 016
JZ0012	SILICONE INSUL. 22*30*0.22MM	4	T 032
LM0340	IC TDA2040V AUDIO POWER AMPLIFIER	14	IC 019
LM0604	IC TDA8172 TV VERT.DEFLECTION	11	IC 016
LM0906	IC 24C04A/P SERIAL EEPROM 512X8	12	IC 026
LM0903	IC MICROCONTROLLER 80C31 DIL–40	17	IC 025
LM0904	IC 27C256 200NS OTP DIL–28	16	IC 023
LM0742	IC TDA8196 VOLUME CONTROL	12	IC 015
LM0777	IC TDA8444 6–BIT OCT.DAC DIL–16	15	IC 021
LM0779	IC 74HCT573 8XLATCH 3–STATE DIL20	6	IC 024
LM0787	IC 74HC390 4–STAGE RIPPLE COUNTER	8	IC 006
LM0901	IC TDA4852 HOR&VERT CONTROLLER	20	IC 008
LM0905	IC M62352P 12–CH 8–BIT DAC DIL20	16	IC 011
LM4015	IC 74HCT574SO	8	IC 022 027
LM4017	IC 74HCT02 QUAD 2–INPUT NOR SO–14	4	IC 001
LM4101	IC 4053B MUX/DEMUX ANAL.3X2–CHAN	7	IC 012 007

Part Number	Description	PG	Item Number
LM4104	IC 4011B 4X2–INPUT NAND SO–14	4	IC 003
LM4105	IC 4046B PHASE–LOCKED LOOP SO–16	6	IC 029
LM4111	IC 4538BT	5	IC 018 030
LM4208	IC 74HC86 2–INPUT EXCL. OR SO–14	4	IC 002
LM4211	IC 74HC123 MONOSTAB.MULRIVIB SO16	8	IC 004
LM4404	IC LM339 4XVOLTAGE COMP. SO–14	4	IC 014
LM4406	IC LM324 QUAD OP–AMP SO–14	5	IC 009 013 017 020
LM4410	IC ICM7555 GEN.PURPOSE TIMER SO–8	6	IC 028
LZ0061	IC–SOCKET 28–POLE DIL DUAL LEAF	6	IC 023
QA0099	CRYSTAL 12.0 MHZ HC–49/U	10	X 001
QK0981	PIN STRIP 1X02 2,5 LUMBERG	3	Q 016
QK1284	ROW CONN 1X02 7,62 VERT/LOCK	2	Q 014 015 011
QK1455	ROW CONN 1X06 2,54 VERT	3	Q 001
QK1464	ROW CONN JST 1X03 2,5 VERT	4	Q 006
QK1492	SP CONN PLUG 2–PIN (SMK)	2	Q 007
QK1494	CONN PLUG FOR DY W–P3005–01	4	Q 009
QK1495	CONN PLUG FOR DY CM16506–0101	4	Q 008
QK1587	COOLING & SUPP.PART FOR RESISTOR	1	
QK1634	ROW CONN 1X04 2,5 V STGLOCK SNAP	3	Q 013
QK1659	SOLDER SUPPORT FOR CABLE 13–POS	3	Q 002
QK1673	SOLDER SUPPORT FOR CABLE 9–POS	3	Q 003
QK1674	FLEX–FOIL CONNECTOR 13–POLE	6	Q 010
QK1684	ROW CONN 1X14 2,5 V STG SNAP	4	Q 004
QK1683	ROW CONN 1X13 2,5 V STG SNAP	3	Q 005
QT0004	SPARK GAP 2,5KV +–500V R=5,0MM	5	GL 002
QT0207	GLIMM LAMP 95V 6*12,5MM	4	GL 001
SE2530	POWER SYNC. JOHTO 447C	8	M 005
SE2542	FLAT CABLE SMA–SMH 9–PIN	11	Q 003
SE2555	FLAT CABLE SMA–SMH 13 PIN	11	Q 002
UC0859	FASTENING SPRING	2	T 009 013 027 039 040 041 042 043 044
UC0859	FASTENING SPRING	2	IC 019
UC1140	HEATSINK	2	IC 019
UC1140	HEATSINK	2	T 013 027 039 040
UC1142	HEATSINK	3	T 009
UC6551	FASTENING SPRING	3	D 051 052
UC6551	FASTENING SPRING	3	IC 016
UC6552	FASTENING SPRING	3	T 032
UC6564	COOLINGPLATE	5	IC 016
UC6664	HEATSINK	14	T 041 042 043 044
UC6738	HEATSINK	15	D 051 052
UC6738	HEATSINK	15	T 032
UC6743	SUPPORT	6	
UC6752	WASHER	1	
UG0790	MODULE SUPPORT	3	
WC0353	PT–SCREW KB 40X10	1	
WC0442	SCREW AB2,9X9,5	1	


SMA136J
SMA161J
SMA142J
SMA162J
SMA143J
SMA157J
D3057J
SB5071J
POWER SYNC
PVM

447E

SMA142J

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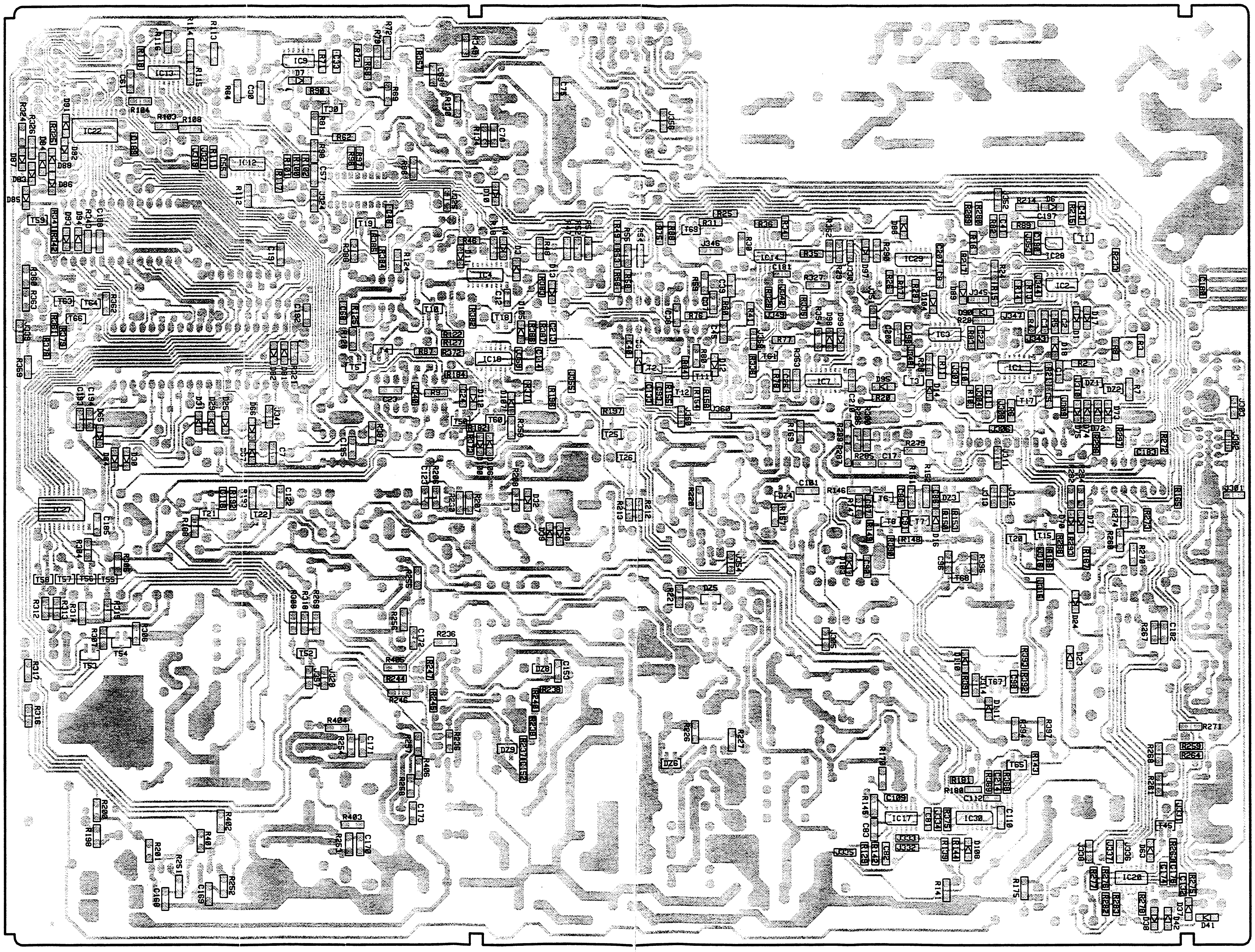

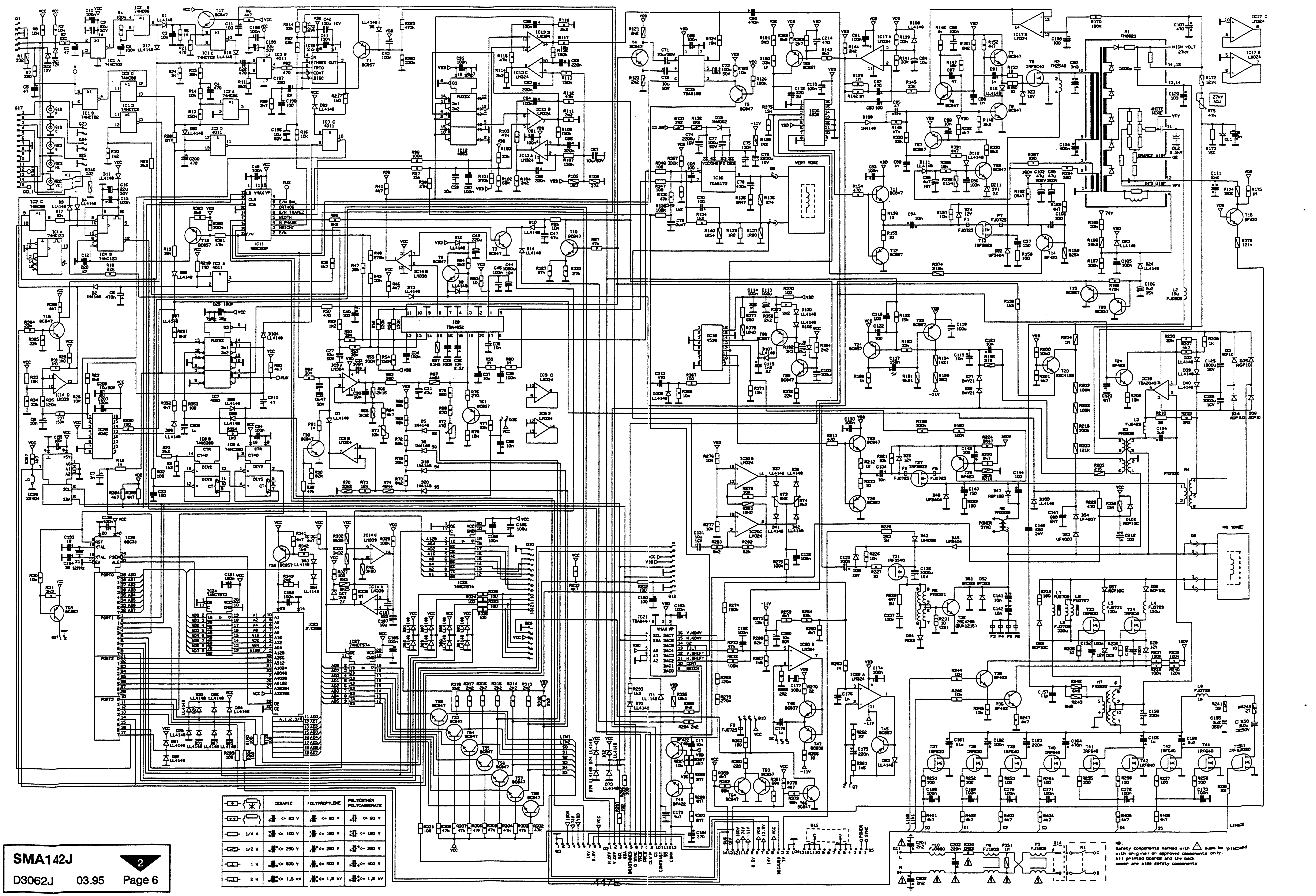
VERT YOKE
HR YOKE
HIGH VOLT 27kV
WHITE WIRE
ORANGE WIRE
RED WIRE
POWER SYNC
LINE

	CERAMIC	POLYPROPYLENE	POLYESTHER POLYCARBONATE
	<= 63 V	<= 63 V	<= 63 V
1/4 W	<= 160 V	<= 160 V	<= 160 V
1/2 W	<= 250 V	<= 250 V	<= 250 V
1 W	<= 500 V	<= 500 V	<= 400 V
2 W	<= 1,5 kV	<= 1,5 kV	<= 1,5 kV

SMA142J

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NB.
Safety components marked with ⚠ must be replaced
with original or approved components only.
All printed boards and the back
cover are also safety components

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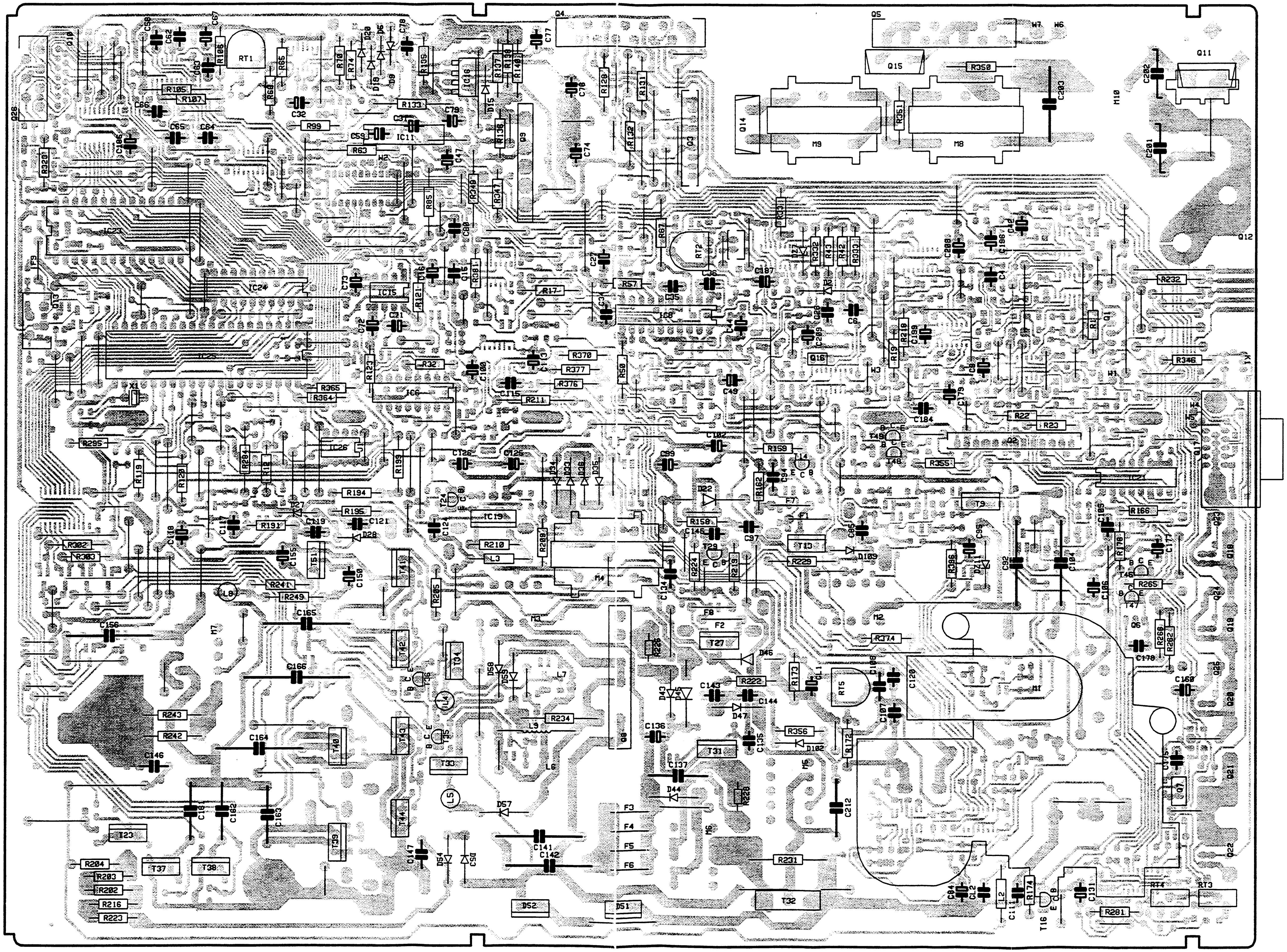


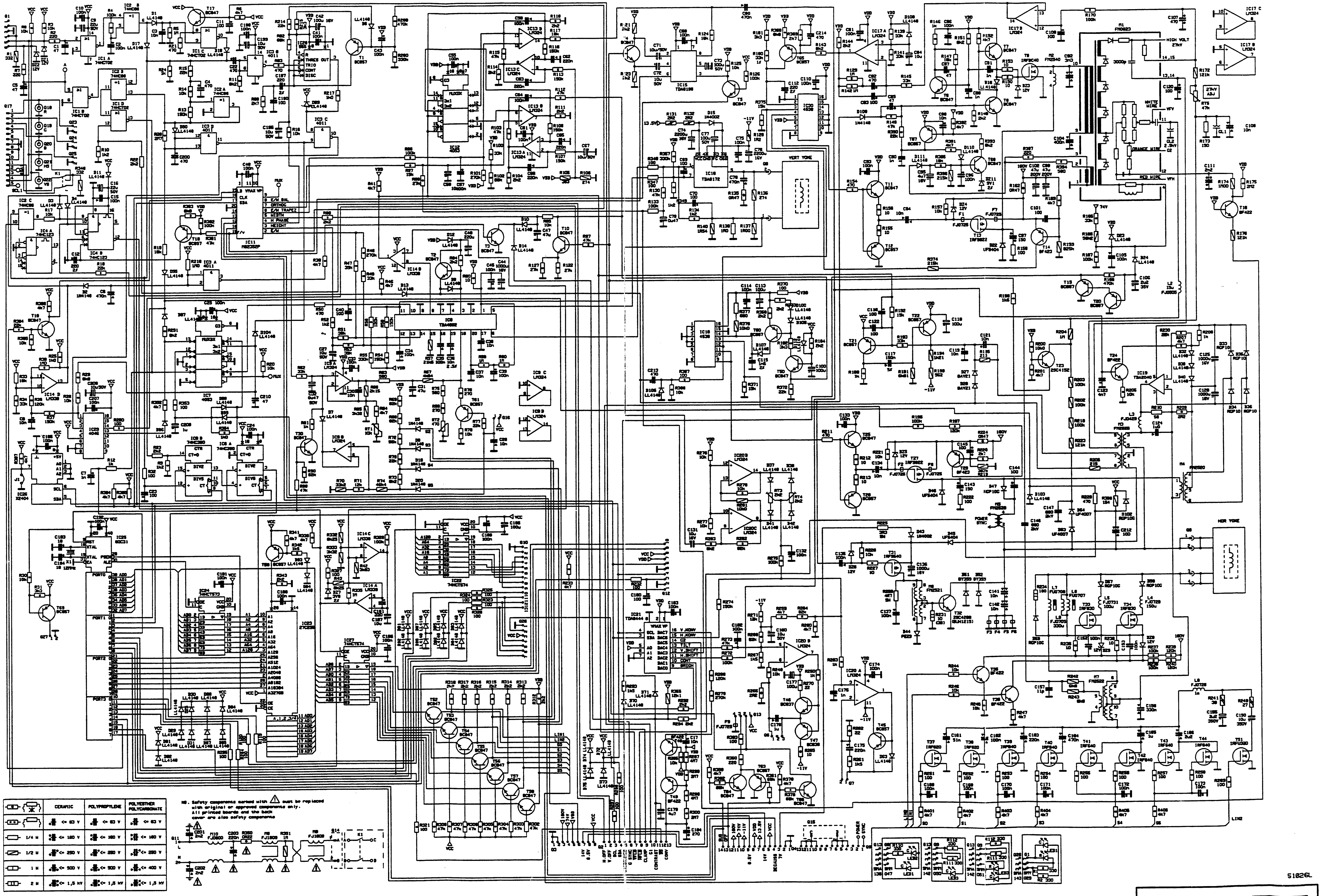
Q4
Q5
W7
W6
Q15
R350
Q11
M10
C202
C203
C201
Q14
R351
M9
M8
Q12
Q10
Q20
C58
C62
C67
C60
R108
RT1
R65
R70
R74
D20
D6
C78
D18
D8
R109
IC10
D15
R137
R138
R140
C77
C76
R128
R131
R105
R107
C66
R68
C32
R133
C79
C65
C64
R99
C59
C31
IC11
R63
W2
C47
R136
Q9
C74
R132
Q3
R320
C106
IC27
R85
R348
R347
C80
R67
RT2
R331
R132
R43
R42
R333
D27
C208
C106
C14
Q13
IC24
C73
IC15
R121
C16
C15
R381
R17
C27
R57
C35
C36
C187
C6
IC8
C30
C44
C209
R310
R19
C198
R1
Q1
R232
IC25
C72
C21
R32
C100
C113
R370
R377
R376
R50
C49
Q16
W3
C39
C179
W1
R346
X1
R122
R365
R364
IC6
C115
R211
C184
R22
R23
Q2
T49
T48
T17
R295
IC26
C126
C125
C99
C102
R159
T14
R355
IC21
R119
R120
R284
R12
R199
D34
D33
D38
D35
D22
R162
C94
F7
F1
T9
R194
D27
R195
C121
T24
IC19
R158
C148
C97
T13
D103
C85
C95
C105
R166
Q23
R302
R303
C18
C117
R191
C119
D28
C155
T51
C124
R210
R209
L3
T29
R224
R219
R229
R396
D21
C92
C104
R170
C17
T46
Q18
C150
T41
R205
M4
C134
F8
C106
R265
T47
Q24
L8
R241
R249
M7
C165
M3
F2
M2
R374
Q6
R260
R282
Q19
C156
T42
T34
R226
T27
D46
C178
D58
D59
L7
C166
T36
T4
C143
R222
R173
C11
C108
RT5
C120
M1
C169
Q26
D43
D45
C144
D47
C107
Q20
R243
R234
L9
C136
R356
R242
C164
T40
T43
T35
C135
D102
R172
C146
T30
L6
Q8
C137
T31
M5
C175
Q21
L5
D57
C18
C162
C163
T44
D44
R228
C212
Q7
F3
F4
F5
F6
T23
T39
C141
C142
M6
Q22
R204
T37
T38
C147
D54
C50
R231
R203
R202
R216
R223
D52
D51
T32
C84
C12
L2
C11
R174
T16
C131
RT4
RT3
R281

Part Number	Description	PG		Item Number
AA0643	R CF 0W25 56R J	1	R	210
AA0649	R CF 0W25 100R J	1	R	119 232 032 284 295 323 120 347 348
AA0653	R CF 0W25 150R J	1	R	173
AA0665	R CF 0W25 470R J	1	R	229 211 050
AA0667	R CF 0W25 560R J	1	R	063
AA0669	R CF 0W25 680R J	1	R	377
AA0673	R CF 0W25 1K0 J	1	R	012
AA0681	R CF 0W25 2K2 J	1	R	022 123 121 023
AA0689	R CF 0W25 4K7 J	1	R	364 365
AA0697	R CF 0W25 10K J	1	R	017 085
AA0703	R CF 0W25 18K J	1	R	033
AA0703	R CF 0W25 18K J	1	R	019
AA0713	R CF 0W25 47K J	1	R	302 303 099 381
AA0721	R CF 0W25 100K J	1	R	133
AA0725	R CF 0W25 150K J	1	R	107
AA0745	R CF 0W25 1M0 J	1	R	218 174
AB0593	R NF 0W25 0R47 J CF	1	R	135 162 224
AB0609	R NF 0W25 2R2 J CF	1	R	209 266
AB0625	R NF 0W25 10R J CF	1	R	265
AB0633	R NF 0W25 22R J CF	1	R	262
AB0649	R NF 0W25 100R J CF	1	R	158 222 370
AB0803	R NF 0W5 1R2 J CF	1	R	128
AB0809	R NF 0W5 2R2 J CF	1	R	131 132
AB0835	R NF 0W5 27R J CF	1	R	249
AB0839	R NF 0W5 39R J CF	1	R	241
AC3550	R SMD 0W1 33K 1%	1	R	180
AC8625	R SMD 0W12 10R J	1	R	155 156 212 213 227 235 236 153 150 080
AC8633	R SMD 0W12 22R J	1	R	270
AC8649	R SMD 0W12 100R J	1	R	363 327 367 321 269 251 252 253 254 255
AC8649	R SMD 0W12 100R J	1	R	256 257 258 290 296 297
AC8649	R SMD 0W12 100R J	1	R	324 325 353 326
AC8657	R SMD 0W12 220R J	1	R	002 007 397 360
AC8659	R SMD 0W12 270R J	1	R	076
AC8659	R SMD 0W12 270R J	1	R	088
AC8665	R SMD 0W12 470R J	1	R	083 154 021
AC8667	R SMD 0W12 560R J	1	R	394
AC8667	R SMD 0W12 560R J	1	R	075
AC8673	R SMD 0W12 1K0 J	1	R	024 354 337 081 146 263 188 250 208 217
AC8673	R SMD 0W12 1K0 J	1	R	025
AC8675	R SMD 0W12 1K2 J	1	R	052 134 349 009 010
AC8677	R SMD 0W12 1K5 J	1	R	198 293 261 342 267
AC8681	R SMD 0W12 2K2 J	1	R	318 086 104 111 114 118 314 315
AC8681	R SMD 0W12 2K2 J	1	R	144 148 292 294 312 313 316 317 184
AC8681	R SMD 0W12 2K2 J	1	R	084 343 358 373
AC8683	R SMD 0W12 2K7 J	1	R	369 089 220
AC8685	R SMD 0W12 3K3 J	1	R	182 215 181
AC8685	R SMD 0W12 3K3 J	1	R	031
AC8689	R SMD 0W12 4K7 J	1	R	038 041 046 152 006 336 233 293 341 352
AC8689	R SMD 0W12 4K7 J	1	R	064 201 386 387 260 247 391 359 259
AC8689	R SMD 0W12 4K7 J	1	R	378 169 392 401 402 403 404 405 406
AC8689	R SMD 0W12 4K7 J	1	R	207
AC8693	R SMD 0W12 6K8 J	1	R	029 383 368
AC8695	R SMD 0W12 8K2 J	1	R	143 283 151 073 393 291 011
AC8697	R SMD 0W12 10K J	1	R	014 026 244 285 078 336 246 206 248 245
AC8697	R SMD 0W12 10K J	1	R	125 157 221 226 200 003 008
AC8697	R SMD 0W12 10K J	1	R	276 277 278 366 385
AC8697	R SMD 0W12 10K J	1	R	020 030
AC8699	R SMD 0W12 12K J	1	R	071 271 016
AC8701	R SMD 0W12 15K J	1	R	192 097 371 375
AC8703	R SMD 0W12 18K J	1	R	117 124 147 395
AC8705	R SMD 0W12 22K J	1	R	015 018 384 077 079 372 214 390
AC8705	R SMD 0W12 22K J	1	R	230
AC8707	R SMD 0W12 27K J	1	R	098 122 127
AC8709	R SMD 0W12 33K J	1	R	034 100 062 139 141 049 145 165 193
AC8711	R SMD 0W12 39K J	1	R	047 051 053
AC8713	R SMD 0W12 47K J	1	R	087 149 130 103 112 115
AC8713	R SMD 0W12 47K J	1	R	308 273 304 305 306 307
AC8715	R SMD 0W12 56K J	1	R	072
AC8717	R SMD 0W12 68K J	1	R	082 102 361 362 379
AC8719	R SMD 0W12 82K J	1	R	282 268 068 069 090 264
AC8721	R SMD 0W12 100K J	1	R	004 096 170 272 126 196 382 237 238
AC8721	R SMD 0W12 100K J	1	R	167 275 328
AC8723	R SMD 0W12 120K J	1	R	035 239 056 197 240 288
AC8725	R SMD 0W12 150K J	1	R	013 037 274 108 113 116 054 058
AC8697	R SMD 0W12 10K J	1	R	031
AC8731	R SMD 0W12 270K J	1	R	279 101 048
AC8733	R SMD 0W12 330K J	1	R	357 280 055
AC8737	R SMD 0W12 470K J	1	R	168 289
AC8745	R SMD 0W12 1M0 J	1	R	005 036 175 059 060 335 129 142
AC8755	R SMD 0W12 2M7 J	1	R	299 300
AC8755	R SMD 0W12 2M7 J	1	R	028
AC8761	R SMD 0W12 4M7 J	1	R	286 287
AC8799	R SMD 0W12 0R0 JUMPER	1	J	301 302 303 304 305 306 307 308 309 310
AC8799	R SMD 0W12 0R0 JUMPER	1	J	311 312 313 314 315 316 360 319
AC8799	R SMD 0W12 0R0 JUMPER	1	J	321 358 359 324 325 329 330
AC8799	R SMD 0W12 0R0 JUMPER	1	J	331 332 333 334 335 338 339 340
AC8799	R SMD 0W12 0R0 JUMPER	1	J	341 342 343 344 345 346 347 348 349 350
AC8799	R SMD 0W12 0R0 JUMPER	1	J	351 352 353 354 355 356 357
AD0395	COMP RES 0W5 6K8 K	2	R	242 243

Part Number	Description	PG		Item Number
AD0445	R COMP 0W5 1M0 K	1	R	351
AG3101	R MF 0W5 1R00 F	1	R	137 138
AG3119	R MF 0W5 1R54 F	1	R	140
AG3319	R MF 0W5 154R F	1	R	356
AG3333	R MF 0W5 215R F	1	R	205 195
AG3343	R MF 0W5 274R F	1	R	106 136
AG3351	R MF 0W5 332R F	1	R	001 346
AG3357	R MF 0W5 383R F	1	R	105
AG3373	R MF 0W5 562R F	1	R	199
AG3409	R MF 0W5 1K21 F	1	R	194
AG3433	R MF 0W5 2K15 F	1	R	066
AG3451	R MF 0W5 3K32 F	1	R	065 333
AG3457	R MF 0W5 3K83 F	1	R	042
AG3465	R MF 0W5 4K64 F	1	R	067
AG3481	R MF 0W5 6K81 F	1	R	191
AG3489	R MF 0W5 8K25 F	1	R	332 043
AG3501	R MF 0W5 10K0 F	1	R	376 281
AG3509	R MF 0W5 12K1 F	3	R	355
AG3533	R MF 0W5 21K5 F	1	R	057
AG3551	R MF 0W5 33K2 F	1	R	070
AG3565	R MF 0W5 46K4 F	1	R	074
AG3573	R MF 0W5 56K2 F	1	R	166
AG3601	R MF 0W5 100K F	1	R	202 203 216
AG3609	R MF 0W5 121K F	1	R	172 176 223
AG3633	R MF 0W5 215K F	1	R	374 396
AG3657	R MF 0W5 383K F	1	R	219
AG3689	R MF 0W5 825K F	1	R	159
AG3701	R MF 0W5 1M00 F	1	R	204
AJ0013	R WW 2W0 0R22 K FP	4	RY	350
AJ0103	R WW 5W0 3R3 K	4	RY	225
AJ0102	R WW 5W0 4R7 K	4	RY	228
AJ2523	R MO 2W0 10R J	2	RA	231
AJ2823	R MO 2W0 180R J	2	RY	234
AQ2213	TPMET. 470R	3	RT	002
AQ2219	TPMET. 47K	3	RT	005
AQ2347	TPMET. 10K	4	RT	001
AQ2435	TPMET. 2K2	3	RT	003 004
CA0318	C CER 680P M 2KV	2	C	147 146
CA0322	C CER 2N2 K 1KV	2	C	111
CA0324	C CER 100P K 1KV	2	C	120
CB0531	C CER 47P J 50V	1	C	085
CB0673	C CER 100P J 50V	1	C	144 145
CB3059	C SMD 220P G 50V	2	C	012 112 197
CB3059	C SMD 220P G 50V	2	C	181
CB4131	C SMD 18P J 50V	2	C	193 194
CB4141	C SMD 47P J 50V	2	C	087 210 001 005
CB4151	C SMD 100P J 50V	2	C	101 116 022 023 083 109 180 190 069 070
CB4151	C SMD 100P J 50V	2	C	040
CB4167	C SMD 470P J 50V	2	C	082 200 213 214 022
CC0110	C CER 150P K 500V	1	C	097 143
CC0140	C CER 270P K 500V	1	C	184
CC0170	C CER 470P K 500V	1	C	004 107
CC0772	C CER 10N Z 50V	1	C	119 121
CC4200	C SMD 1N0 K 50V	1	C	007 090 088 091 176
CC4280	C SMD 4N7 K 50V	2	C	123
CC4320	C SMD 10N K 50V	2	C	003 008 030 037 038 017 098
CC4855	C SMD 100N Z 50V	3	C	002 010 169 024 025 033 041 045 048
CC4855	C SMD 100N Z 50V	3	C	055 170 057 061 068 081 086 093 114 132
CC4855	C SMD 100N Z 50V	3	C	133 152 153 174 171 182 183 185 188 189
CC4855	C SMD 100N Z 50V	3	C	191 192 195 198 207 172 039 043 075 168
CC4855	C SMD 100N Z 50V	3	C	096 110 173
CE0081	C X2 220N K 250VAC	8	C	203
CE0116	C Y 2N2 M 400VAC	4	C	201 202
CE2004	C IMP 100P K 1K6V	3	C	212
CE2234	C IMP 3N3 K 1K5V	4	C	092
CE2363	C IMP 10N J 1K25V	6	C	141 142
CE2802	C IMP 51N J 400V	3	C	161
CE2933	C IMP 100N K 400V	4	C	162 137
CE3020	C IMP 220N J 250V	3	C	163
CE3064	C IMP 330N J 400V	7	C	156
CE3088	C IMP 400N J 250V	7	C	104
CE3113	C IMP 470N J 250V	5	C	164
CE3203	C IMP 1U0 J 250V	7	C	165
CE3292	IMCAP 2U2 J 250V	12	C	166
CG2541	C PPR KP 1N5 H 63V	3		
CG2717	C PPR KP 10N H 63V	3	C	036
CK1388	C PES MKT 10N K 250V	2	C	094 134 108
CK2384	C PES MKT 10N K 63V	2	C	026
CK2627	C PES 100N K 63V	2	C	015 034 035 058 064 105 135
CK2663	C PES MKT 150N J 63V	3	C	117
CK2704	C PES MKT 220N K 63V	3	C	062 066 175 065 063
CK2784	C PES MKT 470N K 63V	3	C	006 080 078
CK2864	C PES MKT 1U0 K 50V	5	C	124 178
CN0126	C ELYT 0U47 M 50V	1	C	079 032
CN0154	C ELYT 1U0 M 50V	1	C	209
CN0250	C ELYT 4U7 M 35V	2	C	179
CN0320	C ELYT 10U M 25V	2	C	169 199 208
CN0370	C ELYT 22U M 16V	2	C	009
CN2566	C ELYT 4U7F M 50V	2	C	095

Part Number	Description	PG	Item Number	
CN0308	C ELYT 10U M 50V	1	C	027 067 071 072 131 187 059 084
CN0308	C ELYT 10U M 50V	1	C	160
CN0372	C ELYT 22U M 50V	3	C	016
CN0423	C ELYT 47U M 50V	2	C	031 047
CN0519	C ELYT 220U M 16V	2	C	049
CN2044	C ELYT 10U M 350V	7	C	150
CN2226	C ELYT 2U2 M 350V	3	C	155
CN2467	C ELYT 47U M 200V	5	C	099 102
CN2539	C ELYT 100U M 50V	3	C	042 073 077 113 118 177 100 186
CN2563	C ELYT 2U2F M 50V	2	C	106
CN2712	C ELYT 1000U M 16V	5	C	125 126 136 044
CN2749	C ELYT 2200U M 16V	4	C	074 076
FJ0429	CHOKE 33UH 10%	4	L	003
FJ0505	CHOKE 15UH 5%	2	L	002
FJ0725	BEAD INDUCTOR MIN IMP360HM	2	F	003 006 001 002 004 005 007 008 009
FJ0728	LEAD INDUCTOR 1000UH 10%	5	L	008
FJ0729	LEAD INDUCTOR 150UH 10 %	7	L	004
FJ0705	CHOKE 330UH	2	L	009
FJ0731	LEAD INDUCTOR 100UH 10%	7	L	005
FJ0800	EMI/RFI CHOKE 60MH 3A(AC)	14	M	010
FJ1826	INPUT CHOKE E30/7 2X6,9 MH	12	M	008 009
FM0623	FLYBACK TRAFO 30...82KHZ	44	M	001
FM2520	INPUT COIL E30 1M35H	14	M	004
FM2521	DRIVER TRAFO	12	M	006
FM2522	DYNAMIC FOCUS TRAFO	13	M	007
FM2525	CENTERING COIL	11	M	003
FM2529	PARALLEL COIL	12	M	005
FM2540	CHOKE	12	M	002
FU0707	FIXED LINEARITY COIL S-N	13	L	006
FU0708	FIXED LINEARITY COIL N-S	13	L	007
JF0025	DI 1N4148 75V 200MA 4N	1	D	002 009 019 020 109 005
JF0032	DI UF4007 1000V 1A 75N	4	D	053 054
JF0033	DI UF5404 400V 3A 50NS	4	D	022 045 046
JF0060	DI 1N4002 100V 1A	1	D	015 043
JF0072	DI BAV21 200V 250MA 50N	1	D	027 028
JF0073	DI RGP10G 400V 1A 150N	4	D	033 034 035 036 047 057 102 058
JF0073	DI RGP10G 400V 1A 150N	4	D	059
JF0106	DI UF2D-7000 200V 2A 50N	3	D	044
JF0165	DI BY359 1500V 5A	13	D	051 052
JF4005	DI LL4148 75V 150MA 4N	1	D	001 007 003 004 090 006 083 008 081 010
JF4005	DI LL4148 75V 150MA 4N	1	D	011 031 013 014 016 039 029 030 023 024
JF4005	DI LL4148 75V 150MA 4N	1	D	025 032 037 038 041 042 063 064 065 066
JF4005	DI LL4148 75V 150MA 4N	1	D	067 071 072 073 074 075 012 107 108 082
JF4005	DI LL4148 75V 150MA 4N	1	D	085 086 087 088 089 084 091 092 093 094
JF4005	DI LL4148 75V 150MA 4N	1	D	095 096 097 098 099 110 111 103 104 105
JF4005	DI LL4148 75V 150MA 4N	1	D	017 018 070 112 100 106
JF4005	DI LL4148 75V 150MA 4N	1	D	040
JH0064	ZDI BZX83C9V1 9.1V 0.5W 5%	3	DZ	011
JH0169	ZDI BZX55B3V9 3,9V 0,5W 2%	3	DZ	007
JH4118	ZDI BZX84C12 12V 0.35W 5%	2	DZ	001 003 004 005 006 008 009 002
JM0074	TR 2SC4288A N 1400V 12A 3M TOP3	23	T	032
JM0205	TR BF423 P 250V 25MA 60M:	3	T	014 029
JM0239	TR BC638 P 60V 1A 50M:	4	T	047
JM0244	TR BF422 N 250V 25MA 60M:	2	T	016 024 035 036 048 049
JM0255	TR BC637-6/-10 N 60V 1A 50M:	4	T	046
JM0310	TR 2SC4152 1500V 0.1A	8	T	023
JM4105	TR BC847B N 45V 0.1A SOT23	4	T	002 003 004 005 006 007 008 011 010 025
JM4105	TR BC847B N 45V 0.1A SOT23	4	T	064 019 053 054 055 056 057 058 050 066
JM4105	TR BC847B N 45V 0.1A SOT23	4	T	017 052 068 030
JM4114	TR BC857B P 45V 100MA 150M:	2	T	001 012 015 021 022 026 045 059 060 061
JM4114	TR BC857B P 45V 100MA 150M:	2	T	063 018 065 020 067
JM4114	TR BC857B P 45V 100MA 150M:	2	T	069
JS0019	FET IRF640 N 200V 18A TO220	13	T	041 042 043 044
JS0019	FET IRF640 N 200V 18A TO220	13	T	039 040
JS0026	FET IRFBC40 N 600V 6.0A TO220 AB	10	T	009
JS0030	FET IRF620 200V 5A 0.8R TO-220	7	T	037 038 051
JS0037	FET IRFU320 N 400V 3.1A 1.8R	11	T	033 034
JS0051	FET IRF9540 P 100V 19A 0.2R TO220	14	T	031
JS0057	FET IRF9622 P 200V 2R4 3A TO-220	9	T	013 027
JZ0005	ISOLATOR PAD 19*13*0.22MM	1	T	041 042 043 044 009 013 027
JZ0005	ISOLATOR PAD 19*13*0.22MM	1	IC	016
JZ0012	SILICONE INSUL. 22*30*0.22MM	4	T	032

Part Number	Description	PG	Item Number	
LM0340	IC TDA2040V AUDIO POWER AMPLIFIER	14	IC	019
LM0604	IC TDA8172 TV VERT.DEFLECTION	11	IC	016
LM0906	IC 24C04A/P SERIAL EEPROM 512X8	12	IC	026
LM0903	IC MICROCONTROLLER 80C31 DIL-40	17	IC	025
LM0904	IC 27C256 200NS OTP DIL-28	16	IC	023
LM0742	IC TDA8196 VOLUME CONTROL	12	IC	015
LM0777	IC TDA8444 6-BIT OCT.DAC DIL-16	15	IC	021
LM0779	IC 74HCT573 8XLATCH 3-STATE DIL20	7	IC	024
LM0787	IC 74HC390 4-STAGE RIPPLE COUNTER	8	IC	006
LM0901	IC TDA4852 HOR&VERT CONTROLLER	20	IC	008
LM0905	IC M62352P 12-CH 8-BIT DAC DIL20	16	IC	011
LM4015	IC 74HCT574SO	8	IC	022 027
LM4017	IC 74HCT02 QUAD 2-INPUT NOR SO-14	4	IC	001
LM4101	IC 4053B MUX/DEMUX ANAL.3X2-CHAN	7	IC	012 007
LM4104	IC 4011B 4X2-INPUT NAND SO-14	4	IC	003
LM4105	IC 4046B PHASE-LOCKED LOOP SO-16	6	IC	029
LM4111	IC 4538BT	5	IC	018 030
LM4208	IC 74HC86 2-INPUT EXCL. OR SO-14	4	IC	002
LM4211	IC 74HC123 MONOSTAB.MULRIVIB SO16	8	IC	004
LM4404	IC LM339 4XVOLTAGE COMP. SO-14	4	IC	014
LM4406	IC LM324 QUAD OP-AMP SO-14	5	IC	009 013 017 020
LM4410	IC ICM7555 GEN.PURPOSE TIMER SO-8	6	IC	028
LZ0061	IC-SOCKET 28-POLE DIL DUAL LEAF	6	IC	023
QA0099	CRYSTAL 12.0 MHZ HC-49/U	10	X	001
QG0364	SLIDE SWITCH 30VDC 0.1A L=4MM	8	K	001
QK0981	PIN STRIP 1X02	3	Q	012
QK1227	ROW CONN 1X07	2	Q	026
QK1284	ROW CONN 1X02 7,62	2	Q	014 015
QK1291	RCA JACK FEMALE FOR CABLE	6	Q	023 024 025
QK1372	MAINS CONN MALE	8	Q	011
QK1464	ROW CONN JST 1X03	4	Q	006
QK1492	SP CONN PLUG 2-PIN	2	Q	007
QK1494	CONN PLUG FOR DY	4	Q	009
QK1495	CONN PLUG FOR DY	4	Q	008
QK1502	HIGH DENSITY D-15 CONN., FEMALE	14	Q	017
QK1563	BNC-CONN FEMALE 75 OHM	14	Q	018 019 020 021 022
QK1587	COOLING & SUPP.PART FOR RESISTOR	1		
QK1659	SOLDER SUPPORT FOR CABLE 13-POS	3	Q	002
QK1675	SOLDER SUPPORT FOR CABLE 2-POS	2	Q	027
QK1673	SOLDER SUPPORT FOR CABLE 9-POS	3	Q	003
QM0142	CABLE ASSY W/MINI PLUGS 200MM RED	15		
QM0143	CABLE ASSY W/MINI PLUGS 200MM BLU	15		
QM0144	CABLE ASSY W/MINI PLUGS 200MM GRE	15		
QT0004	SPARK GAP 2,5KV +-500V R=5,0MM	5	GL	002
QK1683	ROW CONN 1X13	3	Q	005
QK1684	ROW CONN 1X14	4	Q	004
QT0207	GLIMM LAMP 95V 6*12,5MM	4	GL	001
SE2530	POWER SYNC. WIRE	8	M	005
SE2542	FLAT CABLE SMA-SMH 9-PIN.	11	Q	003
SE2555	FLAT CABLE SMA-SMH 13 PIN	11	Q	002
SE2575	WIRE BUNDLE	6		
SE2576	WIRE BUNDLE	6		
UC0859	FASTENING SPRING	2	T	009 013 027 039 040 041 042 043 044
UC0859	FASTENING SPRING	2	IC	019
UC1140	HEATSINK	2	IC	019
UC1140	HEATSINK	2	T	013 027 039 040
UC1142	VERTICAL HEATSINK	3	T	009
UC6551	FASTENING SPRING	3	D	051 052
UC6551	FASTENING SPRING	3	IC	016
UC6552	FASTENING SPRING	3	T	032
UC6564	COOLINGPLATE	5	IC	016
UC6664	HEATSINK	14	T	041 042 043 044
UC6738	HEATSINK	15	D	051 052
UC6738	HEATSINK	15	T	032
UC6743	SUPPORT	6		
UC6752	WASHER	1		
UG0790	MODULE SUPPORT	3		
UJ0125	LEAD BAND SST 1 M	1		
UJ0134	LEAD BAND BLUE	2		
WC0353	PT-SCREW KB 40X10	3		
WC0446	HEX PT-SCREW 2,9X8	1		
WN0154	BRIV-RIVET 3,2MM	2		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IC7 4053
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IC21 TDA8444
IC22 74HCT574
IC23 27C256
IC24 74HCT573
IC25 80C31
IC27 74HCT574
IC19 TDA2040
IC17 LM324
IC20 LM324
VERT YOKE
HOR YOKE
HIGH VOLT 27kV
WHITE WIRE
ORANGE WIRE
RED WIRE
POWER SWITCH
LIN1
LIN2
K1

	CERAMIC	POLYPROPYLENE	POLYESTHER POLYCARBONATE
	<= 63 V	<= 63 V	<= 63 V
1/4 W	<= 160 V	<= 160 V	<= 160 V
1/2 W	<= 250 V	<= 250 V	<= 250 V
1 W	<= 500 V	<= 500 V	<= 400 V
2 W	<= 1,5 kV	<= 1,5 kV	<= 1,5 kV

NB. Safety components marked with ⚠ must be replaced with original or approved components only.
All printed boards and the back cover are also safety components

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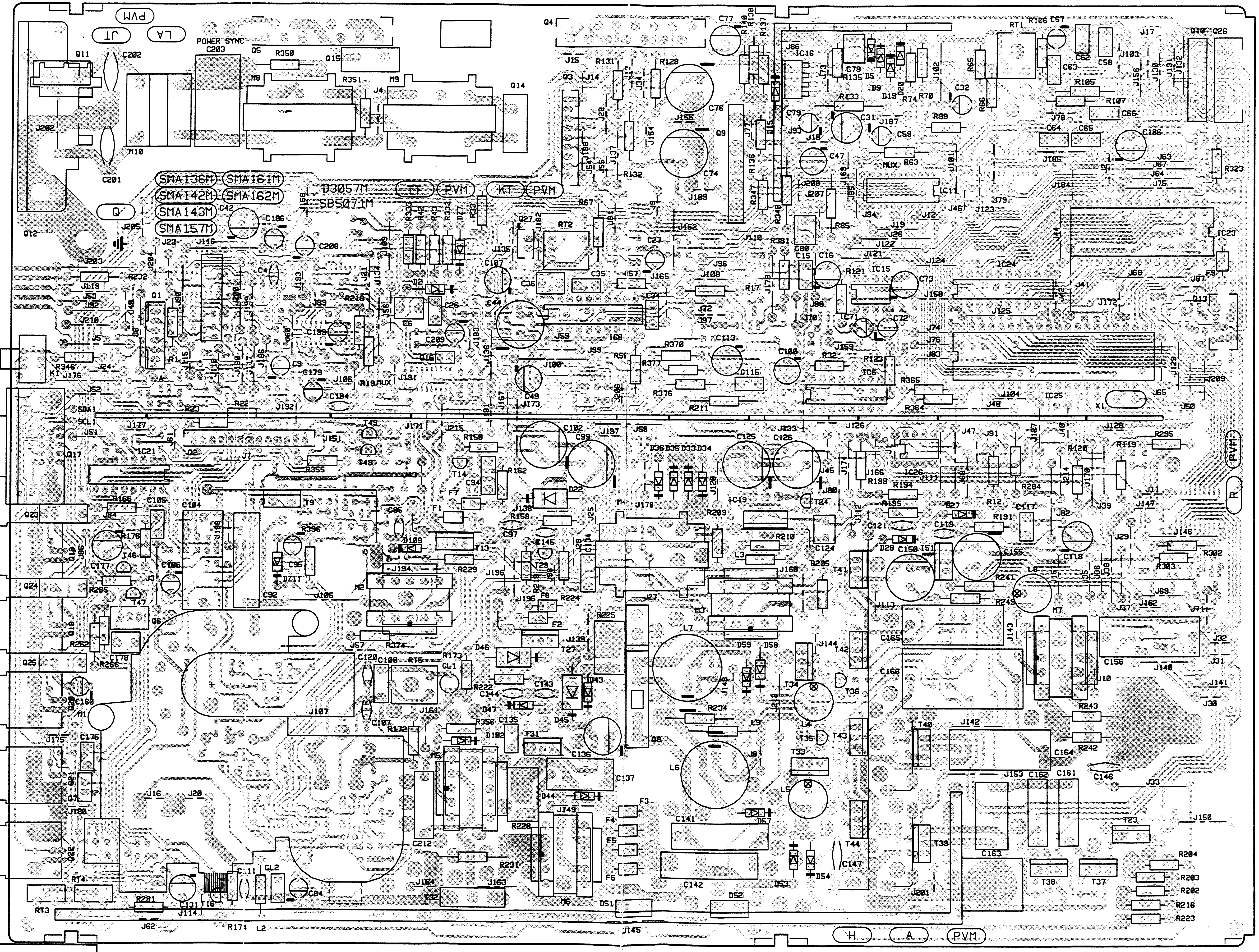
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TT
PVM
KT
PVM
Q
MUX
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PVM

SMA142M

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